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Proceedings of the Twenty-fifth Annual Meeting of the American Association of Economic Entomologists

The twenty-fifth annual meeting of the American Association of Economic Entomologists was held in the Normal School Building, Cleveland, Ohio, January 1–3, 1913.

The business proceedings are given in Part I, while the addresses, papers and discussions will be found in Part II of this report.

PART I. BUSINESS PROCEEDINGS

The meeting was called to order by President W. D. Hunter, at 1.30 p. m., Wednesday, January 1, 1913. The attendance averaged about one hundred and twenty-five members and visitors. The following members were present:

George G. Atwood, Albany, N. Y.; A. W. Baker, Guelph, Canada; C. H. Baldwin, Indianapolis, Ind.; R. W. Braucher, Kent, Ohio; W. E. Britton, New Haven, Conn.; C. T. Brues, Boston, Mass.; A. F. Burgess, Melrose Highlands, Mass.; A. C. Burrill, Madison, Wisc.; Lawson Caesar, Guelph, Canada; S. C. Clapp, Raleigh, N. C.; Mel T. Cook, New Brunswick, N. J.; R. A. Cooley, Bozeman, Mont.; E. C. Cotton, Knoxville, Tenn.; G. C. Crampton, Amherst, Mass.; J. J. Davis, LaFayette, Ind.; G. A. Dean, Manhattan, Kansas; E. B. Engle, Harrisburg, Pa.; Wm. E. Evans, Jr., Painesville, Ohio; E. P. Felt, Albany, N. Y.; S. A. Forbes, Urbana, Ill.; B. B. Fulton, Geneva, N. Y.; P. A. Glenn, Urbana, Ill.; W. H. Goodwin, Wooster, Ohio; H. A. Gossard, Wooster, Ohio; C. H. Hadley, Jr., Durham, N. H.; T. J. Headlee, New Brunswick, N. J.; R. W. Hegner, Ann Arbor, Mich.; Glenn W. Herrick, Ithaca, N. Y.; C. F. Hodge, Worcester, Mass.; W. O. Hollister, Detroit, Mich.; T. E. Holloway, New Orleans, La.; J. S. Houser, Wooster, Ohio; L. O. Howard, Washington, D. C.; H. B. Hungerford, Lawrence, Kansas; S. J. Hunter, Lawrence, Kansas; W. D. Hunter, Dallas, Texas; A. D. MacGillivray, Urbana, Ill.; C. L. Marlatt, Washington, D. C.; P. W. Mason, LaFayette, Ind.; E. W. Mendenhall, Columbus, Ohio; C. L. Metcalf, Raleigh, N. C.; Z. P. Metcalf, Raleigh, N. C.; A. W. Morrill Phoenix, Ariz.; Wilmon Newell, College Station, Texas; W. C. O'Kane, Durham,

N. H.; Herbert Osborn, Columbus, Ohio; Herbert T. Osborn, Columbus, Ohio; J. H. Paine, Washington, D. C.; P. J. Parrott, Geneva, N. Y.; L. M. Peairs, Morgantown, W. Va.; E. F. Phillips, Washington, D. C.; H. J. Quayle, Berkeley, Cal.; W. A. Riley, Ithaca, N. Y.; A. H. Rosenfeld, Tucuman, Argentina; J. G. Sanders; Madison, Wisc.; W. J. Schoene, Geneva, N. Y.; H. C. Severin, Brookings, S. D.; G. D. Shafer, East Lansing, Mich.; N. E. Shaw, Columbus, Ohio; V. E. Shelford, Chicago, Ill.; H. E. Summers, Ames. Iowa; T. B. Symons, College Park, Md.; James Troop, LaFayette, Ind.; Y. H. Tsou, Urbana, Ill.; F. L. Washburn, St. Anthony Park, Minn.; R. L. Webster, Ames, Iowa; W. B. Wood, Washington, D. C.; W. W. Yothers, Orlando, Fla.; J. F. Zimmer, Washington, D. C.

A large number of visitors attended the meetings but it was not possible to secure an accurate list.

PRESIDENT W. D. HUNTER: I have the honor of calling to order the twenty-fifth annual meeting of the American Association of Economic Entomologists. We will first listen to the report of the Secretary.

REPORT OF THE SECRETARY

At the last annual meeting of the Association a large number of associate members were elected and several transfers in the different classes of membership were made. Since that time one active, two associate and one foreign members have died and two active and two associate members have been dropped from the rolls on account of non-payment of dues.

The total membership to date is 133 active, 163 associate and 53 foreign members. This represents a net gain of twenty-six members.

During the year four of our members have been called by death. On March 21, 1913, Dr. John B. Smith, one of the founders of this Association passed away at his home at New Brunswick, N. J. He was one of the men who has made the science of entomology respected and appreciated by the public and the agricultural classes. His tireless energy and willingness to assist the struggling amateur entomologist will cause his loss to be keenly felt by all entomologists.

Edward L. Jenne, an expert of the United States Bureau of Entomology, died on May 10, 1912. He had conducted important investigations on insects affecting deciduous fruits, a part of the results having been published by that Bureau.

Clarence E. Hood died at Urbana, Ill., June 18, 1913, from injuries received in a motor cycle accident. He was carrying on investigations and introducing beneficial insects into Porto Rico previous to his untimely death.

G. H. Grosvenor of Oxford, England, was drowned off the Cornish coast during mid-summer while endeavoring to save the life of another. He was a man of much promise and had been active in his chosen work at Oxford University.

SUGGESTIONS CONCERNING THE JOURNAL

The subscription list of the JOURNAL ought to be materially increased during the coming year. We need to have this publication in the hands of many who do not now subscribe. Every member should interest himself in helping the work along.

Every year there are a number of papers which are presented at the meeting but are withdrawn for publication elsewhere. It would appear that these papers should be published in our official organ if the JOURNAL desires them. Articles published often make sales for the publication as well as extend the interest in the work and purposes of this Association.

At the time the JOURNAL was established it was desired to publish the report of the annual meeting and the papers and discussions early in the year in order that they might be available for use. With the increase in the length of our programs it will soon be impossible to publish the papers at all promptly unless the early issues of the JOURNAL are very large. It would appear, however, that this must be done, or that some time in the future when our finances will warrant, it might be well to consider the publication of an annual report separate from the JOURNAL.

FINANCIAL STATEMENT

The following statement shows a good balance in favor of the Association. Practically all the bills are paid, except the cost of printing the last issue of the JOURNAL and the balance is sufficient to cover that charge.

The bills for dues and subscriptions covering the year 1913 were sent to members in October and many of these have been paid. This explains the reason for the balance being larger than in previous years.

Association Statement

Balance in Treasury, December 23, 1911		$199.88
By amount received for dues, 1912		321.00
To stenographic report 1911 meeting	$40.67	
Stamps and stamped envelopes	30.30	
Printing	37.75	
Printing, Committee on Entomological Investigations	5.20	
Buttons, 1912	10.90	
Telegraph and express	3.80	
Clerical work, Secretary's office	18.00	
Clerical work, Legislative Committee	5.00	
One-half salary of Secretary	50.00	
	$201.62	
Balance, December 23, 1912	319.26	
	$520.88	$520.88

Journal Statement

Balance in Treasury, December 18, 1911		$59.83
By amount received from subscriptions, advertising, etc		1,825.01
To Stamps and stamped envelopes	$44.21	
Printing	1,256.40	
Halftones, etc	66.77	
Telegraph and express	5.80	
Miscellaneous supplies	5.15	
Clerical work Editor's office	85.70	
Clerical work Manager's office	47.00	
Salary, Editor	100.00	
One-half salary of Manager	50.00	
	$1,661.03	
Balance in Treasury December 23, 1912	223.81	
	$1,884.84	$1,884.84

Respectfully submitted,

A. F. BURGESS,
Secretary.

On motion the report was received and the financial part referred to the auditing committee.

PRESIDENT W. D. HUNTER: I will now read the report of the Executive Committee.

REPORT OF EXECUTIVE COMMITTEE

The Executive Committee has held no meetings, but several matters have been considered by correspondence.

A formal invitation to send a representative of the Association to the centenary anniversary of the founding of the Academy of Natural Sciences of Philadelphia was received. Dr. L. O. Howard was selected for this mission.

A delegate to the International Entomological Congress at Oxford in August, 1912, was appointed. A formal memorandum containing the invitation of the Association to the Congress to hold its next annual meeting in the United States was prepared and placed in the hands of Prof. Herbert Osborn, who represented the Association at the meeting.

In September the Secretary received an invitation from the President of the National Conservation Congress to send a delegate to the annual meeting of the organization at Indianapolis in October.

In October the Secretary received a communication from the Secretary of the Farmers National Congress with the suggestion that delegates be appointed to attend the meeting at New Orleans on November 7 and proposing some form of affiliaton.

In both of these cases, on account of the shortness of time, the subject was not referred to the Committee on Affiliation with Agricultural Organizations. The committee decided that it would be unwise to enter into any sort of coöperation. The committee considers that the Association has certain definite aims that are only indirectly connected with the functions of the Country Life Federation and the Farmers National Congress. To extend the activities of the Association in the direction of such coöperation would be a revolutionary change in policy. It would tend to detract from the entity of the Association and to congest still further the business to be conducted at the annual meetings. The committee recommends that the matter be referred to the Committee on Affiliation with Agricultural Organizations for further consideration.

The executive committee was charged with devising means of incorporation. It is to be regretted that the committee has been unable to make any satisfactory progress. One possibility which was investigated was incorporation in the District of Columbia. It was found upon consultation with an attorney and with the District authorites that the present laws would render such incorporation impossible. These laws require that at least a majority of the members of an organization incorporated in the District shall be residents thereof.

As an alternative, incorporation by act of Congress has been considered. The American Society of Florists was incorporated by this means some years ago. We find by correspondence with the men who were connected with this matter that many obstacles were encountered, and it was practically eleven years from the time the idea was first projected until the charter was obtained. During all this time the plans of the Society were agitated by Mr. William R. Smith, superintendent of the Botanic Gardens in Washington. In spite of Mr. Smith's activity and the advantages of his location in Washington, the matter moved very slowly; in some cases it was refused consideration, and in one instance was defeated in one house of Congress after it had passed the other. It was opposed on all sorts of grounds by representatives

and senators from different quarters of the country. Finally it passed both houses of Congress, but was vetoed by President Cleveland. Later Mr. Smith ascertained that President McKinley would sign the bill if it should come to him. After a repetition of the vicissitudes that the previous bill had experienced, it was finally passed and signed by the President. Mr. M. J. Stewart, who was secretary of the Society at the time of incorporation, has written, "It is our conviction that no other human being but Mr. Smith could have accomplished what he did, and, without any reason to discourage you, would say that I think you would find it very difficult to get incorporation by act of Congress."

The Executive Committee recommends that a special committee be appointed to consider further the matter of incorporation.

Under instructions from the Associations the committee referred to the A. A. A. S. a list of the active members with the suggestion that they be made fellows of that association.

W. D. HUNTER,
T. J. HEADLEE,
R. A. COOLEY,
A. F. BURGESS,
Executive Committee.

By vote of the Association the report was accepted and the recommendations adopted.

PRESIDENT W. D. HUNTER: We will now listen to the report of the Committee on Nomenclature by Prof. Herbert Osborn.

MR. HERBERT OSBORN: No list of insect names has been submitted to the committee during the year and, therefore, we have no list to report to the Association. The committee feels that an improvement in the use of common names has resulted from its work. Several books and other publications that have appeared recently have used the names suggested in the lists. We have no further report to make at this time.

By vote of the Association the report was adopted.

PRESIDENT W. D. HUNTER: We will now call for the report of the committee on affiliation with other agricultural organizations. Mr. F. M. Webster is chairman of this committee but as he does not seem to be present, I will call on Professor Forbes for the report.

MR. S. A. FORBES: The members of this committee which included Professor Webster, Professor O'Kane, and myself have never had a meeting. I have just received a letter from Professor Webster in which he says that he will approve any report which Professor O'Kane and myself may make. This being the case I beg leave to report that inasmuch as the present arrangement, whereby this Association holds its meetings at the same time and place with the American Association for the Advancement of Science, and its related societies, is working very satisfactory and that it does not seem advisable to make a change. The committee is of the opinion that the present arrangement in regard to holding annual meetings should be continued.

By vote of the Association the report was accepted and the recommendations adopted.

Owing to the absence of Mr. Sanderson and Mr. Symons the reports of the committees, of which they were chairmen, were postponed until the next session.

A report was read by Mr. Wilmon Newell in behalf of the Association of Apiary Inspectors, as follows:—

APIARY INSPECTORS COMMUNICATION

To the Association of Economic Entomologists: The Association of Official Apiary Inspectors of the United States and Canada, through the undersigned committee, request permission to affiliate with your Association as a "section" thereof, the chairman of such "section" to be a vice-president of your Association, and the proceedings of the "section" be published as are other proceedings of the Association of Economic Entomology.

WILMON NEWELL,
S. J. HUNTER,
T. J. HEADLEE.
Committee.

In view of the absence of Mr. Symons, chairman of the Committee on Affiliation, action on this request was postponed until the next session.

PROF. W. D. HUNTER: We will next listen to the report of the committee on entomological investigations, by T. J. Headlee.

REPORT OF COMMITTEE ON ENTOMOLOGICAL INVESTIGATIONS

Fellow members of the Association:—

Your Committee on Entomological Investigations for the year 1912 herewith presents its report.

At the outset this committee desires to thank the entomologists who have coöperated with it for the courtesy and encouragement with which they have aided its work.

In accordance with the usual custom an information slip was transmitted to the active membership of this society and to all other working entomologists in the United States and Canada, except to those who are connected with authorities that in the past have not seen fit to furnish information. Incidentally some workers now in our active membership list, but employed in other countries, have been reached. The committee felt that the fact that their work and interest have been such as to place them in the active membership is in itself sufficient to render the inclusion of their investigations highly desirable.

At the suggestion of Prof. R. H. Pettit of Michigan and Director C. P. Gillette of Colorado, the committee included in the slip an inquiry looking toward the formation of a taxonomic directory, which it is hoped may aid those of us who need aid in identification and those who are engaged in taxonomic studies.

The response to this inquiry has been very representative, very few of the states in which entomological work is being done failing to reply. The replies clearly indicate, however, that a considerable number, perhaps a little over half, prefer to give merely a statement of names of projects under consideration. No correspondent raised any objection to the taxonomic directory and some warmly commended it.

In accordance with the custom, a preliminary report, including a list of projects and the taxonomic directory, was prepared and has been published in the December issue of the JOURNAL. A few of the replies came after the copy of the preliminary report was sent to the printer, and the data contained in them will be found at the close of this report.

Comparatively few statements were made relative to point No. 4 of the inquiry which was "if you can find time please prepare a brief statement of what you believe to be the characteristic marks of worthy entomological investigation," and such as came indicated such a diversity of opinion that no attempt will be made to review them. In fact, your committee feels that this phase of the inquiry has not received much encouragement.

At the time the Committee on Entomological Investigations was created, it was understood that it should not only further coöperation by making known to all the different lines of study each was pursuing, but that it should stand for ideals of economic entomological investigation. The first part of its duty this present committee has discharged in its preliminary report and in the supplement with which this is closed. The second phase it now proposes to treat.

"Scientific investigation" may be defined as the collection of data relative to a certain definite matter for the purpose of advancing human knowledge of that matter beyond previous limits, and usually involves the formulation and statement of results. Of course, in entomological investigation the data collected relate primarily to insect life, and in economic entomological investigation the data refer to some phase of insect life in relation to human welfare.

No single investigator can exhaust any one department of entomological study and his investigation must necessarily, if it is to serve human kind to best advantage, form one of the building units in the edifice of knowledge. His investigation must, therefore, be so planned, conducted and especially so reported that his co-laborers in

the field, both contemporaneous and succeeding, shall be able to estimate its value and arrange their investigations in accordance therewith.

Too much of the basic data are even yet omitted and the mere conclusions stated. Conclusions are worth little to the investigator, unless he knows the data on which they are founded. This habit of reporting conclusions merely is probably largely due to the necessity under which entomologists have long been laboring, of stating their results in a purely non-technical manner, both for the purpose of saving expense and for rendering the publication "popular." This tendency your committee deplores as one not merely retarding the progress of our science; but as one exhibiting poor business judgment. Ultimately from the standpoint of the public, which we serve, any investigation sufficiently important to induce us to spend our time and the public money upon it must be of enough importance to merit a report sufficiently full that our co-laborers can plainly see from perusing it the reasons for the "faith that is in us" or public funds will have been improperly expended.

Your committee believes that every station where entomological investigations are pursued and the results published, should have at least two series of publications, in one of which data derived from investigations can be so fully stated that workers in other places can draw their own conclusions therefrom, and in the other of which the practical economic outcome of the investigations can be stated in non-technical language for the benefit of the general public.

The qualities of an investigation which render it usable by co-workers are: (1) clear and definite presentation of its relation to preceding work; (2) clear and illuminating arrangement of the new data; (3) a conservative interpretation of the meaning of these data. The first of these points involves a brief but lucid statement of progress along the particular line to the point where the investigator begins his work, and the writer should take especial care to make the references very definite. The second and third points need no amplification as they are already sufficiently explicit.

Your committee feels that the importance of meteorological conditions is such that wherever life history studies are made meteorological records should be kept and that they should be included in the final report.

Your committee believes that the percentage of investigations devoted to the discovery of general laws of reaction is too small, and that the science of economic entomology is now held back by this condition. It desires to urge upon those whose conditions permit, and inclinations adapt, the high importance of emphasizing this phase of entomological investigation.

Your committee desires to commend the practice now gaining in favor of basing recommendations for control of definite insect species on extensive tests under normal field conditions, and to deplore the continuance of the early practice of basing measures of control on merely a study of life economy.

Additions to the List Submitted in Preliminary Report

Note. In a recent letter, Dr. C. Gordon Hewitt, the Dominion Entomologist, requests a correction in the manner of reporting dominion government projects, fearing the method used in the preliminary report might lead the ordinary reader to think he personally is carrying out all of the projects. As a matter of fact Doctor Hewitt says that those projects are being carried on by various members of the Division of Entomology of Canadian Department of Agriculture.

Investigations dealing with Acarina

Montana, Bozeman,—R. A. Cooley.

179. Tick investigations in Montana with particular reference to *Dermacentor venustus*.

Investigations dealing with Orthoptera

Minnesota, St. Anthony Park,—F. L. Washburn.

180. Grasshopper control.

181. Factors in the control of Acrididæ of economic importance. C. W. Howard in immediate charge.

182. Life histories of Orthoptera. C. W. Howard in immediate charge.

Investigations dealing with Hemiptera

Montana, Bozeman,—R. A. Cooley.

183. Life history and control of the sugar beet louse (*Pemphigus betæ*).

184. Study of the control of the oyster shell scale by use of insecticides.

Peru, S. A., Lima,—Charles H. T. Townsend.

185. White scale of cotton (*Hemichionaspis minor*) and its parasites.

About 9 species of microhymenopterous parasites are at work in force on *H. minor* in Piura department, 2 species of coccinellids, 1 or more species of mites, and 1 fungus, and the host shows marked signs of decrease at present in consequence. In Peru the scale is still confined to Piura department.

186. Coccids and microhymenopterous parasites of the same in Peru.

Several hundreds of lots of coccids have been collected and thousands of parasites reared, some two or three hundred slides of latter having been prepared and studied. Many hundreds of microhymenoptera have been collected, and many mounted and studied.

Washington, Pullman,—A. L. Melander.

187. Resistance of the San José scale to insecticides.

While it may be premature to announce that the San José is developing resistant strains in certain localities, yet it is not improbable to assume this. It is certain that the effect of standard sprays varies greatly from place to place, and that the scales of certain districts seem to be acquiring a progressive immunity. I have been working on this for quite a few years now but have withheld a public announcement up to the present. Formerly the sulphur lime was almost a panacea, certainly de-

stroying eggs of red spider, aphis, and the scale. It now seems to have no effect on the first and sometimes but little effect on the others.

Investigations dealing with Lepidoptera

Minnesota, St. Anthony Park,—F. L. Washburn.

188. Spraying experiments for codling moth and curculio. A. G. Ruggles in immediate charge.

Montana, Bozeman,—R. A. Cooley.

189. Life histories and means of controlling the cut worms of Montana.

Investigations dealing with Diptera

Minnesota, St. Anthony Park,—F. L. Washburn.

190. Problems in connection with the larvæ of Muscid flies. C. W. Howard in immediate charge.

Peru, S. A., Lima,—Charles H. T. Townsend.

191. Muscoid fly reproduction investigations.

Hundreds of dissections made of female muscoid-fly reproductive systems, and descriptions and drawings prepared. Papers forthcoming.

Investigations dealing with Coleoptera

Australia, Brisbane, Queensland,—A. A. Girault.

192. Investigations of the sugar cane grubs (scarabeids in general) of Australia. Succeeded in rearing the larvæ to maturity.

Minnesota, St. Anthony Park,—F. L. Washburn and O. G. Babcock.

193. Corn bill bug.

Montana, Bozeman,—R. A. Cooley.

194. Life history and control of the sugar beet silphid (*Silpha bituberosa*).

Peru, S. A., Lima,—Charles H. T. Townsend.

195. Cotton square-weevil (*Anthonomus vestitus*) and its parasites.

About 12 species of hymenopterous parasites are at work, one in very large numbers compared with the others in the coast region of Peru, but they kill only about 18 per cent. of the host. Ants of the genus Solenopsis, very close to *S. geminata*, are present but do not seem to prey upon the weevil. *The weevil requires marked atmospheric humidity* to insure activity. It is known to exist in the cotton districts from Guayaquil south to Tambo de Mora near Pisco, in the lower coast region, but has not yet been found in the foothill cotton districts nor in the montaña.

Investigations dealing with Hymenoptera

Massachusetts, East Wareham,—H. J. Franklin.

196. Bumble bees.

Monograph on bumblebees of the New World soon to appear.

Minnesota, St. Anthony Park,—F. L. Washburn.

197. Clover-seed chalcid, *Brucophagus funebris*. Warren Williamson in immediate charge.

198. Larch saw fly. A. G. Ruggles in immediate charge.

Investigations dealing with groups of insects or with insecticides or with both

Massachusetts, East Wareham,—H. J. Franklin.

199. Cranberry insects (injurious and beneficial).

Progress fully reported in last two annual reports of the Cape Cod Cranberry Growers' Association, and in the last annual report of Massachusetts Agricultural Experiment Station.

Minnesota, St. Anthony Park,—F. L. Washburn.

200. Shade tree pests. A. G. Ruggles in immediate charge.

Pennsylvania, Harrisburg,—H. A. Surface.

201. Susceptibility of varieties of cultivated plants, especially fruits, to insect and plant-disease injury.

202. Improvement of the lime-sulphur solution.

203. Prevention of peach tree borer and certain other orchard pests.

Peru, S. A., Lima,—Charles H. T. Townsend.

204. Cotton insects in general.

Some 38 or 39 different species of insects have been found to attack the cotton plant in Peru, counting several weevils and Heteroptera which have not actually been observed to feed upon the plant but whose presence in the squares makes this habit almost certain; and of these *Hemichionaspis minor* and *Anthonomus vestitus* are especially serious, the latter probably exceeding the former in injury, while *Dysdercus ruficollis* and some 6 or 7 others cause great injury. Seven of these cotton pests are coccids:—*H. minor*, *Saissetia oleæ* (or *nigra*), *Pulvinaria* n. sp., *Coccus hesperidum* (probably), *Orthezia* sp. perhaps *insignis* (Guayaquil), *Dactylopini* sp., Coccid perhaps *Dactylopini*. More than 40 species of enemies, chiefly parasites, aside from those of *H. minor* and *A. vestitus*, have been found to attack these cotton plagues. It may be added that there are at least three serious fungus plagues of cotton in the Peruvian coast region. These observations refer to the coast region only.

205. Transmission of verruga by bloodsuckers.

Careful consideration of all available published and unpublished data seems to indicate almost certainly that verruga is transmitted to man by a tick.

206. Ticks, lice, bloodsucking Diptera and Hemiptera.

Native and domestic mammals examined for ectoparasites and many species found including ticks; many bloodsucking Diptera found, especially Simulium and tabanids in the montaña. Some interesting undetermined forms of ectoparasites found on Oryzomys and bats.

207. Citrus and other fruit pests.

Five serious citrus coccids occur in the coast region. Fruit-fly determined as *Anastrepha* sp. (not *ludens*).

208. Pests of cane, coffee, tobacco and general crops.

Seven serious cane pests occur, including montaña forms. Many pests of crops in general collected and observations noted.

Porto Rico, Rio Piedras,—D. L. Van Dine.

209. General entomological survey of the sugar cane areas of Porto Rico.

We have now a list of some twenty (20) injurious species together with many associated species. The most of this material has been identified by the specialists of the United States Bureau of Entomology at Washington. The character of the injury of these species is understood and so is the comparative amount of damage. A great deal of information has been obtained on the local distribution of the species and the factors that regulate such distribution.

210. General breeding work.

The breeding work has been in progress for only a year but some work has been done on practically all of the species affecting cane and quite a little work on a few of the more important species. At the present time the breeding work relates to the species of Lachnosterna affecting cane in Porto Rico and their local and introduced parasites.

211. Laboratory and office work.

An important start has been made towards building up a general collection of named material.

212. Field work.

A card index record is kept of all plantation inspections with cross references to the field notes on the species observed and to the individual reports sent to the plantations. The results of the coöperative experiments are filed under the species to which they relate.

213. Experimental work.

In the experimental work on the May-beetles an effort has been made to introduce natural enemies from abroad. An agent is working at the present tine in Illinois on the parasites of Lachnosterna in that locality. Various fungi have been introduced from Hawaii, the United States and France. The direct measures, in coöperation with plantations, have included the use of insecticides, repellents and picking the white-grubs behind the plows and the adults from their food plants at night.

As regards the sugar-cane moth stalk-borer, *Diatræa saccharalis*, the egg parasites of the same in Louisiana, Mexico and British Guiana are sought. An agent visited Mexico last season but was forced to return to the United States on account of the political disturbances. The direct measures against this borer include experiments on seed selection, seed treatment, covering of seed, plucking out of "dead" hearts, and the destruction of the trash after harvest.

The experimental work on the mole-cricket, *Scapteriscus didactylus*, includes different systems of planting the cane, cutting to prevent injury and trap light experiments in capturing adults at night.

The work under this heading against the sugar-cane mealy-bug, *Pseudococcus sacchari*, relates to the treatment of seed before planting and seed selection. The lady-bird beetle, *Cryptolæmus montrouzieri*, a mealy-bug feeder, has been introduced successfully from California, through the Audubon Park, New Orleans, laboratory of the United States Bureau of Entomology and has been bred and liberated throughout the cane areas in large numbers.

Washington, Pullman,—A. L. Melander.

214. Endoparasitism.

Substantial progress. Not yet ready to report.

215. Bud weevils.

Quite lately a series of over a dozen species of weevils has been troubling the fruit growers of the Columbia River basin, and elsewhere, by destroying the buds of young trees early in the spring. The damage often has been serious. A concern near Brewster has been manufacturing tree collars of enameled tin to protect against the weevils ascending.

Taxonomic Directory

Muscoid flies

Charles H. T. Townsend, Lima, Peru, S. A., will classify as time permits. Will send names in return for specimens. Correspondents please await further notification regarding permanent address.

Empididæ

A. L. Melander, Pullman, Washington, will classify. Will classify other dipterous groups by special arrangement.

Chalcidoidea

A. A. Girault, Brisbane, Queensland, Australia, will classify.

Bombidæ

H. J. Franklin, East Wareham, Mass., will classify to limit of his spare time.

T. J. Headlee,
Glenn W. Herrick,
W. C. O'Kane,
Committee.

PRESIDENT W. D. HUNTER: Is there any discussion on this report?

MR. H. A. GOSSARD: I would like to inquire of Mr. Headlee as to how many of our working entomologists have declined to make report to this committee. There are a great many workers who are very favorable to this project, particularly if it is supported by all, but there are some who do not care to put themselves at the mercy of investigators who will not report.

MR. T. J. HEADLEE: There are ten states in which entomological investigations are going forward from which no reports have been received. No letters containing refusals have been received. One investigator said he was not in sympathy with the work but submitted a list of projects. With a few exceptions the men who have hitherto supported the work are continuing to do so, and some who have not hitherto reported have this year submitted lists of projects. There seems to be a general feeling among investigators that the only information given with regard to the projects under consideration should be a list of the different lines of investigation.

MR. P. J. PARROTT: I am glad to learn that so many are in sympathy with the work and if it is desired I shall continue to submit a list of our projects. I must confess that I have often wondered whether the method which is being used is accomplishing anything. I have no objection whatever to the work which is being carried on by this committee, but I seriously question if it is worth while.

PRESIDENT W. D. HUNTER: It seems to me that there is an important part of this work which has not been mentioned and which should be of great value to all working entomologists. As the result of the publication of the list of the projects which are being taken up by the various men in different parts of the country each individual has an opportunity to ascertain what others are doing and this will in many cases prevent unnecessary duplication of work. An examination of the projects listed also gives one an opportunity to determine instantly the men who are working on any particular class of investigations so that it is very easy to get in touch with them.

MR, W. E. BRITTON: I have always been in favor of the work of this committee, though I have understood that some workers object to giving out the names of projects. I can see but one reason for this. Some of us are burdened with teaching, inspection, correspondence or other routine work. The funds and time for original research are limited. Each would like to carry on a certain amount of research work and we make our plans to do so, even though in doubt as to whether we shall be able to carry the work through to a finish. If the project is not published and the plans fall by the way, no one is the wiser: if published, then we are obliged to confess our inability

to continue the work. In fact the term project has rather too ambitious a sound for the scattered and fragmentary investigations which are all that some of us are able to accomplish.

PRESIDENT W. D. HUNTER: Are there any further remarks? If not, we will now vote on the adoption of the report of the committee.

By vote of the Association the report was adopted.

PRESIDENT W. D. HUNTER: We will now listen to the report of the employment bureau for entomologists, by Mr. F. L. Washburn.

MR. F. L. WASHBURN: I wish to make a brief report on the work which has been attempted. You all understand that this has been carried on for only one year and is in the nature of an experiment. It has been decided during the coming year that a little more publicity will be given to the work by placing a brief notice concerning it in the JOURNAL OF ECONOMIC ENTOMOLOGY, so that entomologists who wish to secure men may know where to apply and that entomologists desiring employment can have an opportunity of registering with the Bureau, if they see fit. I took charge of this work last year in order to see if a plan of this sort might not be made of value to the Association, and I have consented to continue with the work another year, so that it may be given further trial. The same degree of confidence with the men will be respected as in the past. It should be said, however, that although the Bureau will continue to carry on the matters entrusted to its charge in a strictly confidential manner, that it cannot in any way require the institution or parties, who may desire to obtain men, to do the same. It is proposed during the coming year to reduce the fee for registration from $4.00 to $2.00, as it is believed that the latter amount will be ample to cover the cost of clerical work, postage, etc.

PRESIDENT W. D. HUNTER: What action do you wish to take on the report of the employment bureau?

On a motion by Mr. Gossard the report was adopted.

PRESIDENT W. D. HUNTER: We will next listen to the report by Professor Osborn who was selected to represent this Association at the International Congress of Entomology at Oxford, England.

REPORT OF DELEGATE TO INTERNATIONAL CONGRESS

To the Association of Economic Entomologists:

Your President was so good as to honor me with the duty of serving as a representative of this Association, at the meeting of the Second International Congress, and it is my pleasure to report upon some of the activities of the Congress.

It may be stated at first that from the organization of the Congress, which is made clear in the first volume of proceedings, which appeared only a short time before the opening of the Second Congress, and which had not been distributed at the time of my appointment, it is found that the Congress does not make any provision for the

formal recognition of delegates or representatives from different Entomological Societies. Your representative therefore, can not report any action of the Congress which was taken as a result of consideration or action of the body of delegates but can simply indicate what occurred in the way of general sessions, and of such parts of the business as was transacted by the Congress sitting as a whole, and which consisted mostly of adoption of reports of the Executive Committee. In this connection, it might be in place to state that the organization of the Congress appears to the representative, to be entirely inadequate to the consideration and efficient action upon questions of international concern in entomology, and that while our Society as individual members associating themselves with the Congress and doing everything possible to further its cause and secure an adequate organization, that at present any action that we may take as a Society can serve only as a stimulus for such organization. While there were representatives present from Entomological Societies of Germany, Switzerland, Sweden and other countries, as well as the United States, not any of these was given recognition as such representative and in all votes of the Congress, the votes of such a representative had no more weight than that of some individual, possibly resident of the locality, with no entomological training, but who might have paid the membership fee and secured the rights of membership. Such an organization while eminently democratic can certainly not be looked upon as a basis for coöperation amongst the entomologists or particularly the Entomological Societies of the world, as it must invariably happen each year, that there will be a large local representation far outnumbering individual representatives of Societies from distant countries.

In the matter of nomenclature, a move was undertaken and carried through to secure an international committee, which might present for the approval of the Congress, such regulations as might be agreed upon by the entomologists of various countries. While this is perhaps in the best form possible, it is easy to be seen that there are other questions of international concern, for instance, general postal rules etc., that such a Congress should consider, and with some adequate organization for international representation, such questions can be acted upon in a way that will command the support of the Societies of Entomologists in general. Possibly a resolution of the Society asking the Executive Committee of the Congress, to devise some method of international or Society representation, which would secure something like uniform recognition to the different countries, to be provided at as early a date as possible might have a good effect.

One particular feature of the Congress that may be highly commended is the opportunity given for making acquaintance with the entomologists of the various countries, and there can be little question but this opportunity will be productive and in time be of much worth to the Science of Entomology.

In the matter of social opportunities, the Congress offered many opportunities which were highly appreciated. The receptions, excursions and other social features permitted an excellent opportunity for making acquaintance and such acquaintance was enjoyed much by all present.

The opportunity to see the rich collections in entomology, accumulated at Oxford was also a privilege of no small account. The Congress after its adjournment at Oxford went, almost as a body, to Tring on invitations of Mr. Rothschild and enjoyed an exceptional day in examining his wonderful collection of Lepidoptera and the abundant hospitality which he showed on the occasion.

A considerable number of the members also assembled later in London and gathered incidentally at the Natural History Museum, where the insect collections were the center of attraction.

The invitation of the Society for the next Congress to meet in America for its next

session, was duly presented and your representative urged upon the committee in charge, to the best of his ability, that this country be selected for the next Congress. This was ably supported by a number of other American entomologists, especially certain of the delegates from the Entomological Society of America, but the committee had quite determined upon a European meeting for the next Congress, and our efforts were futile.

We were given, however, cordial assurance of the desire of the Congress to meet in America in the near future, with the quite positive assurance that the next succeeding Congress should come here, if our invitation for the second period be given. Your representative felt free to assure the committee that in all probability our invitation would be as cordial as for the present occasion.

While regretting that this particular mission could not be fulfilled and that there is no more actual growth to report, I desire to urge the Society to extend its cordial support of the Congress, and that as many of the members as possible should become members and if possible attend the next session to be held at Vienna, under the presidency of Doctor Handlirsch, and that we exert our influence toward such a development of the Congress as will serve to make it a world-wide influence in the development of our Science.

Respectfully submitted,

HERBERT OSBORN,
Delegate.

PRESIDENT W. D. HUNTER: I do not think a special motion is necessary relative to this report. I will, however, in behalf of the Association extend our thanks to Professor Osborn.

MR. H. A. GOSSARD: I believe that the position of this Association would be better understood by the International Congress of Entomology, and would be little more emphatic if we should ask that the changes suggested by Professor Osborn be made. I move, Mr. President, that Doctor Forbes and two other members, to be named by the Chair, be appointed to consider this matter and report a resolution for action by the Association before the close of this session.

By vote of the Association this motion prevailed and the following committee was appointed.

Messrs. Forbes, Britton, and Osborn.

Under the head of miscellaneous business the secretary presented an invitation from the directors of the Panama-Pacific Universal Exposition for this Association to hold its annual meeting in 1915 at the exposition in San Francisco. He stated that he had advised the Executive Officer of the exposition that it was the custom of this Association to hold its annual meeting in connection with the meeting of the American Association for the Advancement of Science, but that the matter would be brought to the attention of this Association. The Secretary also presented two designs for permanent buttons for use of the members of the Association, should they care to adopt a button for general use. Some few years ago this matter had been considered by the Association but no definite action had been taken.

By vote of the Association both of the above-mentioned matters were referred to the Executive Committee.

Mr. H. A. Gossard, in behalf of the A. I. Root Company of Medina, Ohio, and of the Ohio Agricultural Experiment Station, presented an invitation for the members to visit the extensive apiaries and plant of the A. I. Root Company and the Entomological laboratories of the Experiment Station at Wooster, Ohio, before the close of the meetings. He stated that arrangements would be made so that this trip could be taken by all members who were interested and had the time at their disposal to do so. The President expressed the thanks of the Association to Mr. Gossard and advised all members who desired to make the trip to arrange with Mr. Gossard.

MR. R. L. WEBSTER: I have a matter which I would like to bring before the Association at this time relative to the Bibliography of Economic Entomology. I was much surprised to learn recently that the publication of this bibliography had been discontinued and that entomologists were now referred to the Experiment Station Record in its place. The references contained in that publication, however, are not so full as most entomologists desire and I think that most of us have found the Experiment Station Record to be an unsatisfactory substitute. The Bibliography of Economic Entomology, as compiled by Henshaw and Banks, has been brought down to 1905, so that it is now about seven years since the last number appeared. Now if the Department of Agriculture at Washington cannot publish this bibliography along the same line as it was published before, it seems to me that this Association should take the matter up. I would like to hear this matter discussed and see if some plan cannot be suggested for the continuation of this valuable bibliography in the future.

MR. E. P. FELT: I very frequently refer to the bibliography of economic entomology, and have always found it extremely useful. There is considerable difficulty in securing all the references to literature on entomology, and as the number of publications are increasing rapidly this will be much more difficult in the future. Something of this nature ought to be published and if it cannot be secured in any other way I think it might be attempted by the Association. Of course, this will mean considerable expense but some way should be found to handle the matter. I would move that this project be referred to a special committee.

MR. W. C. O'KANE: I would like to ask if the Bureau of Entomology does not keep a card index covering the bibliography of economic entomology.

PRESIDENT W. D. HUNTER: As I understand the matter a card catalogue is now kept by the Bureau. It seems to me that it would

be desirable for the Bureau to publish this information in order to bring the references up to date. I believe, however, that the discontinuance of the publication of the bibliography was decided upon some years ago. It may be possible, however, to have this matter taken up and a change in policy adopted.

By vote of the Association the matter was referred to a special committee of three to be appointed by the Chair.

The President announced the appointment of the following committees:

Committee on auditing: Mr. W. W. Yothers, Mr. R. L. Webster.

Committee on resolutions: Mr. R. A. Cooley, Mr. F. L. Washburn, Mr. H. J. Quayle.

Committee on nominations: Mr. E. P. Felt, Mr. S. J. Hunter, Mr. W. C. O'Kane.

Committee on Incorporation: Mr. E. P. Felt, Mr. W. C. O'Kane, Mr. A. F. Burgess.

Committee on Bibliography of Economic Entomology: Mr. S. A. Forbes, Mr. Glenn W. Herrick, Mr. R. L. Webster.

Committee on Amendments to the Constitution: Mr. W. E. Britton, Mr. Wilmon Newell, Mr. A. W. Morrill.

At the morning session, Thursday, January 2, the President called for the report of the Committee for Testing Proprietary Insecticides. The Secretary read a letter which he had received from Mr. Sanderson, chairman of this committee, stating that no work had been done by the committee during the year and suggesting that it be discontinued.

By vote of the Association the report was accepted and the committee discharged.

PRESIDENT W. D. HUNTER: I will now call for the report of the committee on legislation, which has been received from Mr. Sanderson.

REPORT OF THE COMMITTEE ON LEGISLATION

Gentlemen:

Your committee on legislation begs leave to report that it was represented at a hearing on the Simmons bill before the committee on agriculture of the House of Representatives, on February 19, 1912, at which the measure was fully discussed with interested representatives from various parts of the country and by the legislative committee of the American Nurserymen's Association. The committee kept in close touch with this measure after that, and, through correspondence and otherwise, aided in the final passage of the measure on the last day of the session in August last. This act, although not all it might be desired, is a long step in advance, and has already been used to good advantage by the federal board in charge of its enforcement.

Respectfully submitted,

For the COMMITTEE,

E. D. SANDERSON,

Chairman.

By vote of the Association the report was accepted and the committee discharged.

PRESIDENT W. D. HUNTER: The next order of business is the report of the special committee on amending the Constitution.

MR. W. E. BRITTON: In connection with this report I will say that it is the understanding of the committee that it would be desirable, in case the proposed affiliation is brought about between this Association and the Association of Horticultural Inspectors and the Association of Apiary Inspectors, that one vice-president of this Association be a horticultural inspector and that the other vice-president be an apiary inspector. It seems probable that it will also be necessary to divide future meetings into sections and it will be the duty of the vice-presidents to preside as chairmen over the sections which they represent.

REPORT OF COMMITTEE ON AMENDMENTS TO THE CONSTITUTION

The following changes in the constitution have been proposed:

Strike out the first sentence in Article II, Section 1. In the following sentence after the word "entomologists" add "horticultural or apiary inspectors," so that the sentence will read as follows: "All economic entomologists, horticultural or apiary inspectors employed by the federal or state governments may become members." Making the Section read as follows:

SECTION 1. All economic entomologists, horticultural or apiary inspectors employed by the General or State Governments or by the State Experiment Stations, or by any agricultural or horticultural association, and all teachers of economic entomology in educational institutions and other persons engaged in practical work in economic entomology may become members.

In Article III, Section 1, omit the last sentence, which provides for the appointment of the membership committee by the President of the Association.

This committee approves these changes and recommends their adoption.

The constitution provides that all officers and committees not otherwise provided for shall be elected by ballot on the recommendation of the Committee on Nominations. We therefore recommend that a committee on membership be elected at this meeting, one to serve three years, one for two years, and one for one year, and that at each subsequent meeting one member be elected for a period of three years.

Respectfully submitted,

W. E. BRITTON, *Chairman*,
WILMON NEWELL,
A. W. MORRILL,
Committee.

PRESIDENT W. D. HUNTER: I believe it would be well to hear the report of Professor Symons of the Committee on Affiliation with Horticultural Inspectors, before acting on this report.

MR. T. B. SYMONS: I am submitting the following report which is drawn up in the form of a resolution to which is attached a plan of the proposed affiliation:

REPORT OF THE COMMITTEE ON AFFILIATION

Whereas; a committee of this Association has conferred with similar committees of the American Association of Official Horticultural Inspectors and the American Association of Apiary Inspectors for the purpose of considering a plan whereby affiliation may be brought about with this Association, and,

Whereas; it is the opinion of the members of these committees that affiliation is desirable and will bring about better results and at less expense to the members than by maintaining separate and distinct organizations.

Resolved, That the plan outlined below be submitted to each Association concerned at its forthcoming annual meeting and that the same shall be put in force immediately if approved by the Associations concerned.

Plan

In order to bring about affiliation, the American Association of Economic Entomologists agrees to amend its constitution to enable the present members of the American Association of Official Horticultural Inspectors and the American Association of Apiary Inspectors to become members and that said amendment will be made by striking out the first sentence of article II, section 1 of the constitution, which reads as follows: "The membership shall be confined to workers in economic entomology," and in the following sentence after the words "entomologists" there shall be added words "or horticultural or apiary inspectors," so that the sentence will read, "All economic entomologists, horticultural or apiary inspectors employed by the Federal or State governments . . . may become members.

The members of the American Association of Official Horticultural Inspectors and American Association of Apiary Inspectors, who are not at present members of the American Association of Economic Entomologists, will, after making regular application for membership, be admitted on the same basis as other members.

After the affiliation has been accomplished, the annual meetings of the American Association of Economic Entomologists shall be arranged so that the Horticultural Inspectors may meet as the section of Horticultural Inspection, and the Apiary Inspectors may meet as the section of Apiary Inspection and the programs shall be made up so that as few papers as possible of mutual interest shall be presented at the same time before the American Association of Economic Entomologists and its sections.

The American Association of Economic Entomologists further agrees that one vice-president of its Association shall be a recognized Horticultural Inspector and he shall have general direction over and preside at, the meetings of the section of Horticultural Inspection and a similar arrangement shall be put in force for the section of Apiary Inspection. The secretary of the American Association of Economic Entomologists will have charge of the preparation and arrangements for the meetings, the general make-up of the program and the publication of the proceedings of the Association. Each section shall select its own secretary to keep a record of the proceedings and discussions at the sectional meeting and he shall prepare them for publication. It shall be the privilege of each section to bring any matters of special interest in its work to the attention of the American Association of Economic Entomologists for action by that Association.

The proceedings of the American Association of Economic Entomologists and sections, together with such papers as may be presented, shall be given equal privileges for publication in the JOURNAL OF ECONOMIC ENTOMOLOGY.

T. B. SYMONS,
A. F. BURGESS,
T. J. HEADLEE,
Committee.

MR. E. P. FELT: It seems to me that we ought to act first on the report of the committee on amending the Constitution and I move that the report of this committee be adopted.

By vote of the Association the report was adopted.

PRESIDENT W. D. HUNTER: We will now consider the report of the Committee on Affiliation as made by Mr. Symons. What is your pleasure?

MR. T. B. SYMONS: In order to bring this matter before the Association for consideration and discussion, I move that the report be accepted.

MR. W. C. O'KANE: I should like to ask if it is the understanding that the members of the Association of Horticultural Inspectors and Apiary Inspectors be admitted as members of this Association.

MR. T. B. SYMONS: Membership in this Association will, according to the report, be subject to the same requirements as heretofore. The members of the Association of Horticultural Inspectors and Apiary Inspectors who do not at the present time belong to this Association will be admitted if recommended by our membership committee.

MR. W. C. O'KANE: Have you both active and associate members in the Association of Horticultural Inspectors?

MR. T. B. SYMONS: Yes; but at the present time there are only a small number of Horticultural Inspectors who are not already members of this Association.

MR. W. C. O'KANE: Can you tell me how many members of the Apiary Inspectors Association are members of this Association?

MR. WILMON NEWELL: Possibly fifteen or twenty members of this Association are now active members of the Association of Apiary Inspectors.

PRESIDENT W. D. HUNTER: Is there any further discussion? If not, I will now put the motion to accept the report of this committee. The motion was duly carried.

At the afternoon session, January 2, the following report was submitted by the Committee on International Congress of Entomologists, by Dr. S. A. Forbes.

REPORT OF SPECIAL COMMITTEE ON INTERNATIONAL CONGRESS

The committee presents the following resolution:

Resolved, That we desire to express to the management of the Second International Congress of Entomologists our lively interest in the continued success of the Congress movement, our cheerful acquiescence in the decision of the Congress to hold its next session on the continent of Europe rather than in America, and our earnest wish that it may so perfect its organization as to give to its actions and conclusions the authority of a thoroughly representative body. To this end we hope that

it may, at the earliest opportunity, adopt a constitution prepared by a committee of its own appointment, providing for the delegate representation and adequate voting power of the various entomological societies and institutions of the world, and for the election of its own officers and executive agents on nominations to be made by a regularly constituted committee, or by its members in open meeting. Until these or similar steps are taken, we are of the opinion that the recommendations and pronouncements of the Congress are likely to be taken as of no general or permanent validity, but as expressions of opinion, merely, by a majority of the individuals who chance to be present at its meetings.

STEPHEN A. FORBES,
HERBERT OSBORN,
WILTON E. BRITTON,
Committee.

The report was adopted.

At the final session Friday morning, January 3, the following business was transacted:

PRESIDENT W. D. HUNTER: We will now listen to the report of the Auditing Committee by Mr. W. W. Yothers.

REPORT OF THE AUDITING COMMITTEE

We, the undersigned, do hereby certify that we have examined the books, accounts and vouchers of the Secretary of this Association and have found the same to be properly kept and correct.

Respectfully submitted,
W. W. YOTHERS,
R. L. WEBSTER,
Committee.

By vote of the Association the report of this committee was accepted.

PRESIDENT W. D. HUNTER: We will now listen to the report of the Committee on Resolutions, by Mr. R. A. Cooley.

REPORT OF COMMITTEE ON RESOLUTIONS

Mr. President and Members of the American Association of Economic Entomologists:—

Your Committee on Resolutions respectfully submits the following:

Whereas,—The Cleveland Normal Training School has provided this Association with commodious and pleasant quarters and has so generously furnished many other facilities for this meeting, be it

Resolved,—That we extend to the authorities of the Normal School and particularly to Professor Whitman our sincere thanks.

Whereas,—The Association has received many courtesies and evidences of hospitality from Professor Gossard and his associates, be it

Resolved,—That we extend to these gentlemen our appreciation and thanks.

Whereas,—An annually published review of insect outbreaks in the United States is of value as a record and for the information of entomologists, and

Whereas,—The Association regrets the discontinuance of such a review as formerly published in the Yearbook of the Department of Agriculture, be it

Resolved,—That we petition the Chief of the Bureau of Entomology to, in the future, prepare such reviews for publication each year in the JOURNAL OF ECONOMIC ENTOMOLOGY.

Whereas,—It is evident that this Association has attained an enviable reputation and is destined to exercise a still greater influence upon the development of economic entomology throughout the world, therefore be it

Resolved,—That the efforts of the membership committee to maintain a high standard for active membership and to exercise a most careful scrutiny of the qualifications of associate members be heartily endorsed.

Whereas,—Our program is year by year becoming increasingly crowded, be it

Resolved,—That we reaffirm an earlier resolution limiting all papers to fifteen minutes excepting under extraordinary conditions and be it

Resolved,—That in the future members be limited to one paper and be it further

Resolved,—That no papers by non-members be admitted to the program.

R. A. COOLEY,
F. L. WASHBURN,
H. J. QUAYLE,
Committee.

By vote of the Association the report of the Committee on Resolutions was accepted.

PRESIDENT W. D. HUNTER: We will now listen to the report of the Committee on Incorporation, by Mr. E. P. Felt.

REPORT OF SPECIAL COMMITTEE ON INCORPORATION

Your committee after a preliminary consideration of the various problems involved, requests that it be continued and authorized to proceed with the incorporation of the Association, provided it is found practicable and can be accomplished at an expense not to exceed fifty (50.00) dollars.

Respectfully submitted,
E. P. FELT,
W. C. O'KANE,
A. F. BURGESS,
Committee.

By vote of the Association the recommendations of the committee were adopted.

PRESIDENT W. D. HUNTER: We will now listen to the report of the Committee on Membership, by Mr. H. E. Summers.

REPORT OF THE COMMITTEE ON MEMBERSHIP

The Committee on Membership submits the following report and recommendations:

For foreign membership:

Andrew Rutherford, Maryburgh Cottage, Blair Adam, Scotland.

For transfer from associate to active membership:

Burton N. Gates, Amherst, Mass.

E. A. McGregor, Dallas, Texas.

For associate membership:

George G. Atwood, Albany, N. Y.
A. W. Baker, Guelph, Canada.
C. H. Baldwin, Indianapolis, Ind.
E. R. Barber, New Orleans, La.
O. C. Bartlett, Phoenix, Ariz.
G. G. Becker, Fayetteville, Ark.
C. W. Creel, LaFayette, Ind.
J. A. Dew, Auburn, Ala.
W. P. Flint, Urbana, Ill.
Henry Fox, LaFayette, Ind.
B. B. Fulton, Geneva, N. Y.
P. A. Glenn, Urbana, Ill.
C. C. Gowdey, Entebbe, Uganda, British East Africa.
C. H. Hadley, Jr., Durham, N. H.
R. W. Hegner, Ann Arbor, Mich.
C. F. Hodge, Worcester, Mass.
C. W. Howard, St. Anthony Park, Minn.
T. H. Jones, Rio Piedras, P. R.
Vernon King, Wellington, Kans.
Philip Luginbill, Columbia, S. C.
P. W. Mason, LaFayette, Ind.
J. W. McColloch, Manhattan, Kans.
C. L. Metcalf, Raleigh, N. C.
J. D. Neuls, Whittier, Cal.
H. R. Niswonger, Lexington, Ky.
J. H. Paine, Cleveland, Ohio.
T. H. Parks, Greenwood, Miss.
Alvah Peterson, Urbana, Ill.
G. E. Sanders, Ottawa, Canada.
V. E. Shelford, Chicago, Ill.
G. D. Smith, Tallulah, La.
Y. H. Tsou, Urbana, Ill.
H. B. Weiss, New Brunswick, N. J.
R. N. Wilson, Tempe, Ariz.

Delinquent Members

The Committee on Membership wishes to report that six active and eleven associate members are in arrears for dues for two or more years. The committee recommends that the Secretary be instructed to notify these members of their delinquencies and if same are not paid within sixty days that he be instructed to drop their names from the roll.

Membership

The Committee recommends that a member of this Association moving to any other country be permitted to retain his membership if he so desires. It shall not be the policy of the Association to transfer such a member to the list of foreign members.

We also recommend that the Association reaffirm its previous policy of electing to active membership from the list of associate members only.

The committee recommends that in our form for application for membership in

the sentence reading "I hereby make application for membership in the Association of Economic Entomologists," the word "Associate" be inserted before the word "Membership."

H. E. SUMMERS, *Chairman*,
R. A. COOLEY,
WILMON NEWELL,
Committee.

MR. W. C. O'KANE: I move that the recommendations of the committee be endorsed and adopted (carried).

PRESIDENT W. D. HUNTER: Mr. R. L. Webster will now present the report of the committee on Bibliography of Economic Entomology.

REPORT OF SPECIAL COMMITTEE ON BIBLIOGRAPHY OF ECONOMIC ENTOMOLOGY

Your committee appointed to consider the question of the continuation of the bibliography of American Economic Entomology begs leave to report the following resolutions for presentation by this Association to the Secretary of Agriculture.

Whereas,—the Department of Agriculture has published an indispensable bibliography of economic entomology up to 1905 and

Whereas,—the department has discontinued the publication of this bibliography, which is of the highest value and aid to workers in economic entomology in the United States, and

Whereas,—this discontinuance has proved a most serious handicap to the progress of this science in this country, and no publication adequately supplying the same need has taken its place, be it

Resolved,—that the Honorable Secretary of Agriculture be respectfully requested by this Association to continue the publication of this most important and serviceable work.

Your committee further suggests that the President of this Association be asked to appoint a committee of three who, in the event that the Secretary of Agriculture does not see fit to continue the publication as requested, shall consider the possibility of maintaining this bibliography by other means.

S. A. FORBES,
GLENN W. HERRICK,
R. L. WEBSTER,
Committee.

The report was adopted.

PRESIDENT W. D. HUNTER: Next on the program is the report of the Committee on Nominations, by Mr. E. P. Felt.

REPORT OF COMMITTEE ON NOMINATIONS

For president, P. J. Parrott, Geneva, N. Y.

For first vice-president, E. L. Worsham, Altanta, Ga.

For second vice-president, Wilmon Newell, College Station, Tex.

For councilors of the American Association for the Advancement of Science, H. E. Summers, Ames, Ia., E. D. Sanderson, Morgantown, W. Va.

For members of the Advisory Board of the Journal of Economic Entomology, C. P. Gillette, Fort Collins, Col. W. E. Hinds, Auburn, Ala.
For the committee on nomenclature, W. E. Britton, New Haven, Conn.
For committee on Entomology Investigations, W. C. O'Kane, Durham, N. H.
For committee on membership,
For three years, Wilmon Newell, College Station, Tex.
For two years, R. A. Cooley, Bozeman, Mont.
For one year, H. E. Summers, Ames, Ia.

E. P. FELT,
S. J. HUNTER,
W. C. O'KANE,
Committee.

MR. H. E. SUMMERS: I move that the report be adopted.

By vote of the Association the Secretary was instructed to cast a ballot for the members recommended as officers by the committee.

The ballot was cast and the officers were declared duly elected.

MR. WILMON NEWELL: I would like to ask if the action taken by the Association on the report on affiliation, presented by Mr. Symons, is final.

PRESIDENT W. D. HUNTER: As I understand it the action taken on that report settled the matter finally.

MR. WILMON NEWELL: Because of the fact that a number of the members are not clear as to the provisions made in the report I move that the adoption of that report be reconsidered.

After considerable discussion, the most of which was of a technical and parliamentary nature, it was voted that the report be reconsidered. Thereupon a motion was made by Mr. Newell that the second paragraph in the report, under the heading "plan," be amended to read as follows: "Members of the American Association of Official Horticultural Inspectors and American Association of Apiary Inspectors who are not at present members of the American Association of Economic Entomologists, may make regular application for membership in the latter Association.

By vote of the Association the amendment prevailed and the report was changed accordingly.

PRESIDENT W. D. HUNTER: Is there any further business before we proceed to adjourn?

SECRETARY A. F. BURGESS: I move that the next meeting be held in conjunction with that of the American Association for the Advancement of Science at Atlanta, Ga.

Carried.

Adjournment.

PART II

PRESIDENT W. D. HUNTER: I will ask first vice-president Headlee to take the chair.

VICE-PRESIDENT HEADLEE: We will now have the pleasure of listening to the annual address of the President.

AMERICAN INTEREST IN MEDICAL ENTOMOLOGY

By W. D. HUNTER, *Bureau of Entomology*

INTRODUCTORY

There is no doubt that medical entomology is the branch of the science which is most in the public eye at this time. The discoveries that have been made in very recent years are most astonishing in their importance and equally so in the rapidity with which they have crowded upon one another. We are inclined, possibly, to look upon medical entomology as a subject which is of more vital interest to other nations than it is to the United States. A large portion of the literature is devoted to sleeping sickness, filariasis, trypanosomiasis and other diseases which have not yet affected directly the people of this country. General interest in the subject has recently been intensified by a number of noteworthy publications by Americans, but the writer is under the impression that the general importance of the subject is not fully realized by American entomologists. It is for this reason that the opportunity is taken to point out some of the respects in which American entomologists are especially concerned.

There is danger that the recent activity in England through the schools of Tropical Medicine and the Entomological Research Committee will tend to place other countries ahead of this one in their contributions to medical entomology. Foreign nations recognize that in applied entomology there is only one field in which we are surpassed, namely, the study of forest insects. In that field we are making rapid progress, and a distinguished German student, Dr. K. Escherich, has recently written that unless his country bestirs itself, it will soon be distanced by the United States. Considerations other than our obligations to our constituents therefore impel us to view the subject of medical entomology with some attention.

We do not overlook the fact that work done in America has affected profoundly the subject throughout the world. The work of Smith and Kilbourne on splenetic fever of cattle helped to lay the original foundation for the study of insect-transmitted diseases. This discovery, following Manson's work on Filaria transmission by a

mosquito, changed all the conventional conceptions regarding a large class of diseases, and has been the stimulus to all of the discoveries that have followed. Moreover, the work of the Reed commission in Cuba added the third important disease to the list of those transmitted by insects as necessary agents. The carefulness of the experimentation was a model for subsequent work. Later, in the control of yellow fever in Cuba by the destruction of the mosquito conveyor, the United States made a most important contribution to the subject. Still more recently the sanitation of the Canal Zone has been an extensive and inspiring object lesson to other nations.

While this work has been going on other phases of the subject have received attention in this country. Dr. L. O. Howard has been the foremost contributor. His work on mosquitoes and the house fly, and numerous papers on the economic losses caused by insects have been a powerful influence in bringing about a realization of the necessity of the study of insects in connection with diseases. The climax of this work is the elaborate monograph of the Culicidæ which is about to be issued by the Carnegie Institution. Other entomologists have also added to the available knowledge. Doctor Felt, Doctor Forbes, Professors Doane and Herms of California, Mr. Bishopp, Professor Cooley and Mr. Brues have advanced the subject very materially. Impressive as this list of contributors is, as we shall attempt to show, it does not represent more than a small fraction of the work that is demanded.

The Function of the Entomologist in the Investigation of Insect-borne Diseases

As this is a rather new subject and our conceptions in some respects are not fully clarified, we may find it useful to refer to the function of the entomologist in the study of diseases. In doing so we acknowledge without reservation that it is primarily the medical profession that has benefited the world by work on insect-borne diseases. Smith and Kilbourne, Ross, Manson, Reed and his colleagues, Marchaux and Salembeni, Dutton and Todd and Ricketts—all intimately associated with splendid achievements—were not entomologists.

In the first place entomologists are needed in the experimental work that will lead to either a demonstration or a denial of the existence of insect porters of any particular malady. Suppose, for instance, we have a disease the etiology of which is obscure and which theoretically may be transmitted by insects. The first step to be taken is to determine what insects should be taken into consideration. Here the knowledge of the entomologist on the life history and habits of the different species comes immediately into play. He can furnish an

intelligent list of suspects, whereas the non-entomological investigator would be compelled to grope about in the darkness and might experiment for years along fruitless lines. In this connection let us refer to the work of Reed and his colleagues on yellow fever. That was a case in which no time was lost and in which it might appear that a knowledge of entomology had little to do with the solution. In making plans to determine whether an insect was the transmitter of the disease, Doctor Reed and his colleagues went to Doctor Finlay. He was not an entomologist, properly speaking, but had been studying mosquitoes for many years. These studies made him familiar with the habits of the Cuban species. He had learned that one species alone should be considered. He had specimens in his possession and actually gave Reed the eggs from which were bred the first mosquitoes that conveyed yellow fever in the experiments. To this extent the work of the Reed commission was started without delay on the right course on account of the entomological knowledge of Doctor Finlay. Moreover Reed and his collaborators were in constant communication with Doctor Howard and spent some time in Washington studying mosquitoes while the Cuban experiments were under way.

When a list of possible transmitters of a disease is formulated and transmission experiments begin, the work of the entomologist is even more essential than before. It is necessary to obtain specimens, breed them and handle them. Immediately a host of points about feeding and manipulation come up, and here again the entomologist is the only man who can supply the information. Suppose the investigation has been continued and it has been found that one or more species are the sole or important agents in the transmission of the malady. At this juncture the work of the entomologist becomes more important than at any other time. In fact, here something close to a separation between entomology and medical science takes place. The control of the disease becomes a question of the control of the transmitting agent and no one can deny that the entomologist is more fitted than anyone else to devise means for the control of insects and to carry them out.

The present practical unanimity of opinion that the primary method of controlling insect-borne diseases is through attack against the insect host and that the control of the human host is secondary is the outcome of practical experience. After the demonstration of the carriage of yellow fever by the mosquito, the first idea of medical men was to control the human host by isolation and to suppress the insect host only as a supplementary measure. The work of Gorgas at Havana in 1901, of Liceaga in Vera Cruz, of White in New Orleans and of Gorgas in Panama was all based upon this conception. But now

the very men who accomplished this magnificent work have changed their views. We quote from Dr. H. R. Carter, "Yet Gorgas now believes, and I think all who participated in the work here concur with him unreservedly, that his success in Havana and on the Isthmus was due to the war waged against the Stegomyia directly, by the destruction of their breeding places, undertaken as an adjuvant to the isolation of the sick, rather than to that isolation itself; to the control of the insect rather than of the human host."

As Doctor Carter points out, the elimination of the disease by the management of the human host failed because that host could not be controlled. We believe that the experience with yellow fever will be duplicated in practically all insect-borne diseases. Apparently healthy carriers will always interfere with attack against the disease through the human host. Nothing short of the suppression of the insect host will yield satisfactory results, and it is most encouraging that medical men seem practically universally to have arrived at this conclusion. The recent work of Celli in Italy in which medication with quinine rather than Anopheles destruction is the basis, is an exception.

The recent work on *Stomoxys calcitrans* and poliomyelitis shows in a striking manner one of the incidental reactions of such discoveries on the entomologist. The work of Brues, Sheppard and Rosenau elevates the stable fly immediately from a position of one which has but little interest, except in connection with live stock, to one of extreme importance in connection with a most distressing human disease. Full information regarding the fly is immediately demanded. We turn to the literature to find it, but discover that as far as the American writings are concerned everything is covered in an aggregate of six to ten pages. It now becomes necessary for the entomologist to study the insect in all its habits and stages.

There are probably many cases in which insects come into important connection with diseases other than as carriers. Take the case of pellagra, for instance. The students of this malady are divided into two very distinct schools: those who believe in the causation by spoiled corn and those who adhere to the theory of insect transmission. If the zeistic school, to which practically all of the Italian investigators belong, should be found to be right, insects would still come into consideration in connection with the deterioration of the corn. In this country, as elsewhere, the injury to corn by insects begins in the field and continues when the harvest is placed in storage. Thus if it is an Aspergillus or a Penecillium that causes the disease, the insects injuring the stored product and starting decay are likely to have some connection with it.

Coöperation Necessary

This subject is one in which coöperation by a number of classes of investigators is indispensable. Everyone must admit that experiments in disease transmission by insects should be conducted coöperatively by entomological and medical men. Neither class can do the best work and obtain definite results without loss of time unless the other one works shoulder to shoulder with it. In this respect, however, medical entomology does not differ from other departments of the science. In spraying work, for instance, the entomologist necessarily coöperates with the chemist and horticulturist. In the medical work he must coöperate with the clinician, the bacteriologist and the protozoölogist, but the share of the work devolving upon the entomologist in one case is certainly as great as in the other.

The recent excellent work of Brues, Sheppard and Rosenau is an example of the rapid progress that can be made and the satisfactory results that can be obtained when the proper coöperation of the two interests concerned is established. The same advantage is expected in the present work of the Bureau of Entomology on the possible transmission of pellagra by insects. Messrs. A. H. Jennings and W. V. King, who are engaged in this investigation, have conducted their studies in the closest coöperation with the Thompson-McFadden Pellagra Commission of the New York Post-Graduate School of Medicine headed by Capt. J. F. Siler, of the Army Medical Corps, who, by his work in Italy and elsewhere, has become one of the foremost students of the disease.

Importance of Medical Entomology in the United States

One very recent event which has caused medical entomology to become of more direct concern to the people of the United States is our territorial expansion. We now have the Hawaiian Islands, the Philippines, Guam, Porto Rico and the Canal Zone. In these possessions many of the insect-borne diseases which do not occur within the United States proper are known to exist. Military and commercial interests cause intimate intercourse between this country and the outlying possessions. This naturally has the effect of greatly increasing the importance of full knowledge regarding any insects which may transmit these diseases if they become introduced.

However, the great importance of insects concerned in the transmission of disease, from the American standpoint, is not connected with tropical maladies which may be introduced and become epidemic here, but with a number of important endemic diseases. In the case of man we have malaria, dengue, spotted fever, a form of ophthalmia,

typhoid fever, tuberculosis, leprosy, poliomyelitis, dysentery and other diseases in which insects are known to be concerned. In the case of diseases of domestic animals we have splenetic fever of cattle, and there is a strong suspicion that infectious anemia of horses is transmitted by *Stomoxys calcitrans*, to say nothing of the possible presence within our boundary also of spirillosis of fowls transmitted in other countries by a tick which is very common in the Southwest.

In the group of exotic diseases of man we have yellow fever, plague, cholera and others. Our public health service is wide awake and efficient, but the impossiblity of preventing the invasion of our country by exotic diseases is shown by the presence of plague in California and the outbreak of yellow fever in New Orleans not later than 1905. As long as it seems to be humanly impossible to prevent the invasion of such diseases, the study of the native insects which can transmit them will require investigation.

The danger of the introduction of new diseases in this country is illustrated in a case of shipment of Indian cattle which was brought to New York a few years ago. In order to be safeguarded, a veterinarian accompanied the importer to India where he made repeated blood examinations of every animal that was selected. Such care is not exercised with human immigrants. The examinations were continued while the cattle were en route. As an extra precaution the animals were kept at quarantine off the harbor at New York for some weeks. Here it was found that the trypanosome which is the causative agent in surra was present. It is not difficult to imagine similar cases in which diseases might pass through the quarantine. In the case of surra, for instance, we have a number of species of insects that can carry it from one aninal to another. In fact, we have one of the identical species, *Stomoxys calcitrans*, which has been proven to be a transmitter of this malady in the Philippines and elsewhere.

Narrowing our inquiry we will now consider the four specific diseases of man and one of cattle occurring in the United States, which, as far as known, are transmitted only by insects. These are malaria, dengue, spotted fever, typhus, and splenetic fever of cattle.

Very recently students of conservation have furnished data that lead to much greater exactness in the determination of the losses caused by human diseases than was formerly possible. The most notable work of this kind has been done by Prof. I. Fisher of Yale University. As the result of most careful calculations he has concluded that the average economic value of the lives now sacrificed by preventable diseases is $1,700. He has also estimated in certain cases the loss due to invalidism not resulting in death. These determina-

tions have been used as a basis in certain calculations we have made but in the case of malaria we find reliable figures already available.

Dr. L. O. Howard has made a very careful and conservative estimate of the loss to the United States due to malaria. His conclusion is that $100,000,000 per year is a fair estimate. The writer's studies have convinced him that this estimate is extremely conservative. If the full effects of the depreciation of land values due to the presence of mosquitoes and the hindrance to development were to be taken into consideration the figures would have to be raised considerably.

Spotted fever causes about fifty deaths per year and there are about four hundred cases of invalidism not resulting in death. On the basis mentioned, the deaths represent a money value of $85,000 and the invalidism $15,000, or a total of $100,000 annually.

Rather exact estimates of the losses due to splenetic fever of cattle have been made. A very reasonable figure which has been practically agreed upon by a number of investigators is $100,000,000 per year.

The other diseases included in the list of those transmitted solely by insects, namely, typhus and dengue, are not covered by absolutely definite statistics at the present time. In case of dengue it is probable that many cases are included in the reports on malaria. Typhus fever is of no great importance although it is probable that a surprising number of cases will be found in the cities that receive a large inflow of immigrants from Europe and Mexico as a recent publication of the Public Health Service shows that Brill's disease is nothing but typhus. In view of the absence of exact statistics it had been considered best to discard these two diseases for the present.

To summarize the losses due to diseases transmitted exclusively by insects, for which statistics are available, we have:

Malaria	$100,000,000
Spotted fever	100,000
Splenetic fever	100,000,000
Total	$200,100,000

We now proceed to a number of important diseases which are not transmitted exclusively by insects, but by them to a greater or lesser extent. These are: tuberculosis, typhoid fever, enteritis and diarrhea and dysentery. The most important of these is tuberculosis which, according to Professor Fisher's statistics, causes a total loss to the people of the United States of over $1,000,000,000 annually. There are no data available, as far as the writer knows, which would give a definite basis for estimating the proportion of deaths from tuberculosis which are chargeable to insects. Recent work on the longevity

of the tubercle bacillus throws considerable light on the likelihood of insect transmission. It has been found, for example, that the longevity of the organism increases enormously as the environment changes from light and dry to dark and moist. In other words, the highest longevity occurs in exactly such places as are best adapted for the breeding of the house fly. We consider that in all probability one twentieth of the cases are contracted through the agency of insects. We, therefore, have a probable annual loss in the United States of $50,000,000 due to insects in connection with tuberculosis.

In the case of typhoid fever, considering that one fifth of the loss is due to insects, we have a total of $70,000,000 per year.

In the group of enteritis and diarrhea no estimate of the total loss seems to have been made. From the census report covering the years 1900 to 1904 we find that the number of deaths per 100,000 from these diseases was 112.8. The death loss for the United States, on the basis of life value of $1,700, would be $178,000,000 annually. To this we judge there must be added at least an equal amount of loss on account of invalidism. We consider that one tenth of the loss may be due to insects. This gives a total of $35,000,000 per annum chargeable to insects in connection with these diseases.

In the same way we conclude that the losses due to insects that are concerned in the carriage of dysentery amount to $2,800,000 per year.

In making the estimate of the cost of invalidism due to enteritis and diarrhea and dysentery we believe that we are more than conservative. In the cases of the three important diseases; namely, malaria, tuberculosis and typhoid fever, for which statistics are available, the total loss is eight times the death loss, but in these instances we have estimated the total loss as only double the death loss.

We may summarize the losses due to the two classes of insects which we have discussed, as follows:

Malaria	$100,000,000
Splenetic fever	100,000,000
Spotted fever	100,000
Tuberculosis	50,000,000
Typhoid fever	70,000,000
Enteritis and diarrhea	35,000,000
Dysentery	2,800,000
Total	$357,900,000

We are certain that in making our estimates we have leaned far towards the side of conservatism. For the moment we have not considered poliomyelitis, pellagra and several other maladies at all, and other expenses chargeable to insects have been omitted. Take, for

example, the expenses arising from quarantines. The precautions that are taken against the introduction of yellow fever, cholera and other epidemic diseases are large, to say nothing of the expense of the control of plague which is already introduced in this country.

It must also be borne in mind that we are only beginning to acquire definite knowledge regarding insects which transmit diseases. The extent to which this is done in cases where something is known about transmission is probably greater than we believe, and, moreover, we must consider the possible discovery of insect causation of diseases which are not at present included in the category of those borne by insects at all. It was but yesterday that the connection between poliomyelitis and the stable fly was discovered and no one knows what addition to our knowledge will be made tomorrow.

The extent to which the importance of insect disease transmitters seems certain to increase can be realized by considering poliomyelitis. The statistics relating to this disease are very unsatisfactory on account of the apparently great increase in the number of cases within the last few years. The latest statistics available give the deaths from this malady in 1909 as 569 in the registration area of the United States which represented at that time 55.3% of the total population of the United States (*Frost Public Health Bulletin* 44, page 8). The same authority gives statistics which indicate an average death rate of 7.7% If we estimate the number of cases from the non-registration area in proportion to those in the registration area in the United States (it may be incorrect on account of the greater occurrence of the disease in the northeastern part of the country where practically all of the states are in the registration class), and use the mortality rate mentioned, we find an annual loss for the United States in the value of lives of $1,734,000. The 13,000 cases of invalidism suggested by these statistics would represent a money loss of $10,404,000, or a total from the disease of $12,138,000. If insect transmission transpires to be as important as the work of Brues and others indicate, at least one tenth of the cases may originate through the attacks of *Stomoxys calcitrans*. This would add over a million dollars annual loss to the estimate we have given.

In all of these estimates we have omitted, altogether, an important group of incidental expenses that is chargeable to insects. This concerns the warfare that is waged throughout the country against numerous species which are merely nuisances and not, as far as known, concerned in the transmission of diseases. The house fly and various non-pathogenic mosquitoes are combated by various mechanical devices, such as screening, the expense of which, as Doctor Howard has pointed out, probably aggregates ten million dollars annually.

In addition to this charge the amount expended in lotions and such preparations must be very considerable.

Agricultural and Vital Losses Compared

We are in now a position to compare the losses due to insects which carry diseases with those which affect the crops grown in the United States. The most complete account of the total losses caused by insects to farm products with which we are familiar is that of Mr. C. L. Marlatt in his paper in the Yearbook of the Department of Agriculture for 1904. He estimated a total loss of $795,100,000. Our estimate of the losses caused by disease transmitted by insects is approximately one half as great as that caused to all farm products. It is altogether likely that the actual losses will very nearly equal those occurring with farm products. Surely this is a sufficient argument for greater attention to medical entomology.

A few comparisons are of striking interest. The codling moth, according to Mr. Marlatt's estimate, causes an annual loss in the United States of $20,000,000, or only a fifth of that due to the insects connected with either malaria or tuberculosis transmission. The loss due to the Hessian fly varies greatly from year to year but is estimated as averaging about $40,000,000, less than one half that occurring in the case of malaria. The damage to all the cereal crops in the United States is only equal to that occurring in tuberculosis and malaria combined, while the damage to natural forests and forest products is estimated to be the same as that in either malaria or tuberculosis.

To obtain a foundation for the comparison we have made we have attempted conservatively to reduce the loss in human life to a pecuniary basis. Although this may have been useful in impressing the point, it really does an injustice to medical entomology. The two branches are radically different in one important respect. One deals with material losses and the other with a reduction in the vital force of the nation. Is it right to compare the loss of a human life with the loss of 28 bales of cotton or 1700 bushels of wheat? The loss in cotton or wheat might be made good in another region or during another season, but for the life that is lost there is no compensation. The recent developments, therefore, bring a new interest into entomology and also give to the entomologist a portion of the respect and honor which has always been given the physician on account of his work in saving and prolonging life.

Extent of Present Work on Medical Entomology in the United States

We now come to the question of how extensively entomologists in this country have occupied the field of medical entomology. The present membership of this Association is 359. Perhaps a score out of this number, that is, 5 per cent, are more or less concerned with medical entomology. This number includes those who teach medical entomology in connection with other branches of the subject, as well as others who have administrative work on many species affecting agricultural products and minor projects connected with disease transmitting species. In all probability the time put in on the subject by all entomologists in this country who have anything whatever to do with the medical side of entomology would not be more than equivalent to the full time of ten members, or 2 per cent of the Association. We shall consider, however, that an equivalent of full time of 5 per cent of the membership is engaged in this way. It has been pointed out that the losses to the people of the United States caused by insects aggregate at least one half of the losses to agricultural products. On this basis, if entomologists covered the field of medical entomology as thoroughly as they do that of agricultural entomology in this country, there would be 169 engaged altogether in that line of work. Out of 154 projects included in the report of the committee on entomological investigations, only eight deal in any sense with medical entomology. These are distributed over only six states, one of them having two projects of the kind and each of the others one. Could there be a more striking illustration of the neglect of our opportunities?

There is one point the writer desires to make in order to obviate a possible misconstruction of his position. We have compared medical and agricultural entomology and have contrasted the amount of work in each field which is now under way in this country. Much as we urge the necessity of more work in medical entomology, we do not desire to see it undertaken at the cost of a reduction in the work on agricultural entomology. Possibly there are a few cases in which the work on agricultural pests might be curtailed, as, for instance, where stations in neighboring states have similar projects on the same species, but the writer believes in the idea expressed repeatedly by the lamented Dr. John B. Smith, that many men with their different viewpoints might well be employed on the same project, and that there is hardly such a thing as useless duplication in entomological problems. Moreover, one discovery opens new fields. Coquillett's work on cyanogen did not settle the question of fumigation, but led to a host of problems about dosage, plant susceptibility and procedure. The devising of a plan of campaign against a pest leads to the necessity of demonstrations

for the benefit of farmers. Thus the field of agricultural entomology is far from being covered adequately. But along with agricultural entomology, and in no way interfering with it, there should develop a medical entomology of a magnitude in some degree commensurate with its importance.

Conclusion

Applied entomology is a science of recent development. We are working in a new country and with a multiplicity of important pests. We have no occasion to be dissatisfied with the progress that has been made. The facts that the science has recently developed, that the forces at work have been far from adequate, that the majority of entomologists are engaged by institutions devoted to advancing agriculture in a rather strict sense, and that medical entomology is a domain that has only recently been opened, are the reasons for the comparative neglect of the subject. The work that confronts us now is to survey that domain and occupy it. Humanity and the destiny of economic entomology demand that we do so.

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VICE-PRESIDENT HEADLEE: In accordance with the provisions of the Constitution discussion on this address will go over until the next session, and I will now retire from the chair in favor of the President.

PRESIDENT W. D. HUNTER: We will now proceed with the reading of the papers on the program, and I will call for the paper by Mr. George A. Dean on "Further Data on Heat as a Means of Controlling Mill Insects."

FURTHER DATA ON HEAT AS A MEANS OF CONTROLLING MILL INSECTS

By Prof. George A. Dean, *Entomologist, Kansas State Agricultural College and Experiment Station*

Two years ago the writer read a paper before this Association on "heat as a means of controlling mill insects." At that time, although the heat method had been used successfully in one or two flour mills, it was still in the experimental stage. However, within the last two years this method has been so developed that now a large number of mill men are satisfied that it is the only practical and efficient method at present known of completely controlling all classes of mill-infesting insects. In Kansas the heating of more than twenty mills has absolutely proven that no stage of an insect, even in the most inaccessible places, could withstand the heat, and several flour mills in Ohio, Illinois, Indiana, Iowa, Nebraska, southern Canada, and elsewhere, have corroborated the practicability and the efficiency of heat as a means of controlling mill insects.

If a mill is infested with the several stages of the confused flour beetle (*Tribolium confusum*), and the other little rust red flour beetles, the cadell (*Tenebrioides mauritanicus*), and the sawtoothed grain beetle (*Silvanus surinamensis*), the treatment heretofore used is of little value, for these insects are found in cracks and in accumulations of fine stuffs inaccessible to any gas. After one has visited flour mills throughout this country, and has made inspections of flour arrivals at the principal ports along the Gulf, the Great Lakes, the Atlantic seaboard, and in Europe, he will soon discover that the confused flour beetle and the cadelle, the larval stages of which are causing so much trouble in flour, are found in practically every flour mill in this country, southern Canada, and Europe. After inspecting this flour and the ports of this country and Europe, through which the flour from many of our mills is handled either for domestic or foreign trade, one is not only convinced that it is this class of mill insects that is causing the serious trouble, but that the large majority of the infestations originates at the mills. One will also be convinced that the hydrocyanic acid gas method, as well as others that are in common use, is inadequate and that something more effective must be used if we are going to control this class of insects.

A Brief Summary of the Successful Heating of a Few Mills

No. 1. During the summer of 1910, a 1,000-barrel frame mill in Topeka was given a thorough fumigation with hydrocyanic acid gas.

No mill could have been given a better fumigation with the gas, and yet a few months later this mill was showing evidence of serious insect infestation. The following spring this mill was given a second fumigation with hydrocyanic acid gas. One month later insects were in sufficient numbers to cause trouble. During the month of June, without any change or additional radiation in the heating system of the mill, the heat was turned on one Sunday morning and continued until nearly Sunday midnight. The examination the next day showed that far more insects were killed than in the gas fumigations, and inasmuch as the examination several months later failed to reveal a single live Mediterranean flour moth in any stage, the manager of the mill was satisfied that it was a far more effective and practical method. Later additional radiation was installed in this mill, and it now has a most effective system.

No. 2. During the summer of 1910, a 1,500-barrel mill of Wellington, Kansas, was fumigated with hydrocyanic acid gas. The expense of the fumigation was over $225, which does not include the shut-down of three days. Before the summer season had passed, not only the common mill insects were again becoming abundant, but the Mediterranean flour moth was doing serious injury. The following summer after installing additional radiation at an expense of not more than that of one fumigation, the mill was heated from Sunday morning until Sunday midnight. A careful examination the next day showed that no insect escaped death on the floors where the heat ranged from 115° to 130° F. No part of the mill was injured by the heat. The examination one year later showed that the Mediterranean flour moth was completely eradicated. The president of the milling company said of the heating method, "I am confident that the method is a great success. We find that after subjecting our mill to heat for eighteen hours, not a creature which was exposed to the heat lived."

Heating of Mills in Ohio.[1] Professor Gossard, entomologist of the Ohio Agricultural Experiment Station, in his annual report for the year 1911, recommends the heat as a practical and a most efficient method, and speaks of several mills in which the heat was used successfully. The millers in his state who have used heat are convinced that it is the cheapest and the most effectual method for the control of mill insects. In Bulletin No. 234 of the Ohio Agricultural Experiment Station Mr. W. G. Goodwin, the assistant entomologist, makes the following summary relative to the heat method:

"It is the most thorough method of treatment for the control of insects infesting flour mills; it requires but one treatment per year to

[1]Annual Report of the Entomologist, Ohio Agr. Exp. Sta., 1911.

completely rid the mill of insect pests and no preliminary cleaning is necessary.

"It is not dangerous to human life as are all of the other fumigants which are even fairly effective.

"There is no possibility of injuring floors, belts, or machines, and practically no danger from fire.

"The cost of a treatment, after the heating system is installed, is less than one fiftieth of that of hydrocyanic acid gas fumigation.

"No time is lost in getting ready to use heat. The mill does not need to be shut down several days beforehand, and as most of the Ohio flour mills use steam power, the cost of a heating system would not be prohibitive. High temperature, as compared with other methods of treatment, by saving time and extra expense, will pay for the average heating system required in a flour mill in less than five years."

GOVERNMENT RECOMMENDS THE HEAT METHOD.[1] During the summer of 1911, the United States Department of Agriculture had one of the experts of the Bureau of Entomology stationed in the southeastern part of the United States to carry on experiments for the control of mill insects in rice and peanut mills. In a recent publication of the results of these experiments, the Government has approved of the heat method and recommends it as a most efficient method in the control of insects in this class of mills.

THE AMOUNT OF RADIATION REQUIRED

The number of square feet of radiation surface required to heat a given number of cubic feet depends upon the condition and the construction of the building, the number of windows and doors on each floor, the character of the machinery, and the location of the steam pipes. Usually one square foot of radiation is sufficient to heat from 50–100 cubic feet of space. A mill that has sufficient radiation to heat it in winter to a temperature of 70° without the heat of the running machinery, can readily be heated in summer to a temperature of from 120–125°.

If the mill is a five-story building, the writer would suggest for the first floor one square foot of radiation to 50 cubic feet of space; for the second floor one square foot to 60 cubic feet; for the third floor one square foot to 75 cubic feet; for the fourth floor one square foot to 90 cubic feet; and for the fifth floor one square foot to 110 cubic feet. If the building is four story, one square foot of radiation to 50, 60, 75, and 100 cubic feet of space for the first, second, third, and fourth floors respectively is recommended.

[1]Cir. No. 142, Bureau of Entomology, U. S. Dept. of Agr.

TABLE SHOWING THE RADIATING SURFACE PER LINEAR FOOT, AND THE LINEAR FEET OF PIPE REQUIRED TO MAKE ONE SQUARE FOOT OF RADIATING SURFACE

Size of pipe in inches	Radiating surface per linear foot	Linear feet of pipe per square foot of radiating surface
1	0.346	2.9
1¼	0.434	2.3
1½	0.494	2.0
2	0.622	1.6
2½	0.753	1.3

In case steam pipe is used for the radiation, either one and one-fourth or one and one-half inch pipe is recommended as the most practical size.

Some Very Important Points to be Considered in the Successful Heating of a Mill

1. The steam pipes should be located near the floor and so arranged as to give an equal distribution of heat.
2. There should be a water trap to draw off all water accumulating in the pipes.
3. The lower floors and the floors with heavy machinery should have more radiating surface in proportion to the cubic feet of space to be heated than the upper floors and the floors with the light machinery.
4. The steam should be turned on with 25–50 pounds pressure, so as to heat the mill more rapidly.
5. In order to take advantage of the heat in the machinery, the heat should be turned on immediately after shutting down the mill.
6. Stairways and elevator shafts should be closed, so as to make each floor entirely separate.
7. Two or three thermometers should be distributed on each floor in order to know what temperatures you have.
8. Time must be taken to reach the desired temperature.
9. A temperature of from 118° to 125° is sufficient for any part of the mill.
10. This temperature should be held several hours to allow the heat to penetrate all the infested parts.
11. Do not attempt to heat a mill on a windy, a cold, or a rainy day.

The Effect of Heat Fumigation Upon Flour

In connection with heat fumigation, the question naturally arises as to whether the heat would have any deleterious effect upon the baking quality of the flour. To give data upon this subject baking tests were made of a patent hard-wheat flour, a low grade hard-wheat

flour, and a pancake flour. These flours were subjected to a heat several degrees higher than that recommended for a mill. The low grade hard-wheat flour was not only subjected to a temperature of 140° for nine hours, but the same samples were reheated to the same temperature two and six weeks later to ascertain whether a second and third heating of the same flour would have any injurious effect. The pancake flour was subjected to a temperature of 130° for forty-eight hours. The baking tests of all these experiments showed conclusively that the heat had absolutely no deleterious effect upon the baking qualities of the flours.

Some Uncalled for Criticisms

The objection made by some that the insurance companies will not permit heat is without any foundation. The only instances of an objection of this sort that has been brought to the attention of the writer was in case of mills that may be equipped with the automatic sprinkling system. Mr. William Reed, secretary of the Mutual Fire Prevention Bureau, representing eight of the principal millers' insurance companies, in a recent notice to all policyholders makes the following statement: "We propose to advocate the heating systems for effective fumigation against the Mediterranean flour moth, weevil, and all other mill and grain infesting insects." The objection that the system is not practical because of the impossibility of heating in winter is one scarcely worth considering. No one is advocating the heating of a mill in winter. Any one familiar with the insect infestation of a mill knows that if a mill is heated during the latter part of the summer and all the insects killed, there will be no necessity for heating during winter months. The objection that heat will injure the belting, check the elevator legs and the woodwork of the bolters and purifiers is without a semblance of truth. In one experiment the mill was heated far above the required temperatures, some of the temperatures going as high as 150° F., for a period of nearly thirty hours, and the examination showed absolutely no injury to any part of the mill or the mill machinery.

Summary of Results

In a mill, flour accumulates in recesses and insects breed in places inaccessible to the gas or vapor of any fumigating material, but heat passes through all of these obstructions and penetrates the innermost recesses! Many mill insects do not yield readily to hydrocyanic acid gas, but no mill insect can withstand for any length of time a temperature of from 118° to 122° F. The writer has fumigated many mills

with hydrocyanic acid gas, but in no case has the fumigation with gas proven so successful as the heating of several mills. In the heating of these mills it has been demonstrated that the heat is the most practical, efficient, convenient and least expensive method. To fumigate with hydrocyanic acid gas requires from two to three days, and this long shut down with the additional cost of material is a large item of expense, besides an element of danger to the operator, while with heat, since it can be applied from Saturday evening until Monday morning, there is no loss of time, very little expense, and no danger to the life of the operator.

TEMPERATURE RECORDS AND OTHER DATA OF SOME MILLS THAT HAVE USED HEAT SUCCESSFULLY

R. E. Kidder Flour Mills, Kansas City, Kansas

Capacity of mills, 600 barrels.
Building, brick.
Date of heating, July 7–8, 1912.
Character of day, partly cloudy and calm.
Outside maximum temperature, 91 degrees.
Outside minimum temperature, 73 degrees.
Heating system, steam pipes along the wall, except in space beneath the first floor where radiators are used.
Steam pressure maintained during the heating, about 20 pounds.

First Floor

Capacity of floor, 28,728 cu. ft. Amount of radiation 525 sq. ft.

READING OF THERMOMETERS

Time of day	Thermometers		
	No. 1	No. 2	No. 3
	Degrees	Degrees	Degrees
10.30 a. m., 7–7–12	83	90	86
11.30 a. m.	83	94	88
12.30 p. m.	84	98	91
2.30 p. m.	88	104	96
3.30 p. m.	90	106	100
4.30 p. m.	93	107	102
5.30 p. m.	94	110	103
7.00 p. m.	95	110	107
8.30 p. m.	97	113	108
9.30 p. m.	98	115	108
9.00 a. m. 7–8–12	100	122	117
11.00 a. m.	106	124	116
12.00 m.	106	125	118
2.00 p. m.	106	128	118
4.00 p. m.	107	129	120
5.30 p. m.	108	129	121

Location of Thermometers

No. 1. In 2 inches of flour in elevator boot on floor 8 feet beneath steam pipes.
No. 2. Hanging in middle of room 5 feet high, 15 feet from steam pipes.
No. 3. In 2 inches of flour in elevator boot on floor, 12 feet from steam pipes.

Result: Failed to reach killing temperatures in elevator boots on the floor, except directly over radiators in space beneath the floor. Killing temperatures reached in all other parts of the room.

Second Floor

Capacity of floor, 28,728 cu. ft. Amount of radiation 560 sq. ft.

READING OF THERMOMETERS

Time of day	Thermometers		
	No. 1	No. 2	No. 3
	Degrees	Degrees	Degrees
10.30 a. m. 7-7-12	98	97	99
11.30 a. m.	105	97	106
12.30 p. m.	110	98	111
2.30 p. m.	117	100	118
3.30 p. m.	120	102	121
4.30 p. m.	123	104	123
5.30 p. m.	125	105	125
7.00 p. m.	127	108	127
8.30 p. m.	129	109	129
9.30 p. m.	130	111	129
9.00 a. m. 7-8-12	140	122	140
11.00 a. m.	142	125	142
12.00 m.	144	126	144
2.00 p. m.	144	127	144
4.00 p. m.	147	129	147
5.30 p. m.	146	131	145

Location of Thermometers

No. 1. Hanging in open 4 feet high, 15 feet from steam pipes.
No. 2. Between rolls in roller, 11 feet from steam pipes.
No. 3. Hanging in open 6 feet high near roller machinery.

Results: One hundred per cent of the insects were killed.

Third Floor

Capacity of floor 3,112 cu. ft. Amount of radiation 460 sq. ft.

READING OF THERMOMETERS

Time of day	Thermometers		
	No. 1	No. 2	No. 3
	Degrees	Degrees	Degrees
10.30 a. m. 7-7-12	95	85	89
11.30 a. m.	100	88	91
12.30 p. m.	105	91	95
2.30 p. m.	114	100	102
3.30 p. m.	116	102	103
4.30 p. m.	119	105	107
5.30 p. m.	122	107	108
7.00 p. m.	124	111	111
8.30 p. m.	126	113	113
9.30 p. m.	127	114	114
9.00 a. m. 7-8-12	133	126	125
11.00 a. m.	138	127	125
12.00 m.	139	127	126
2.00 p. m.	141	128	128
4.00 p. m.	143	128	131
5.30 p. m.	145	129	131

Location of Thermometers

No. 1. Hanging in open 5 feet high, 15 feet from steam pipes.
No. 2. In flour in conveyor near floor, 12 feet from steam pipes.
No. 3. In flour in conveyor 6 feet high, 15 feet from steam pipes.
Results: One hundred per cent of the iusects were killed.

Fourth Floor

Capacity of floor, 43,092 cu. ft. Amount of radiation 400 sq. ft.

READING OF THERMOMETERS

Time of day	Thermometers		
	No. 1	No. 2	No. 3
	Degrees	Degrees	Degrees
10.30 a. m. 7-7-12	96	88	88
11.30 a. m.	100	90	90
12.30 p. m.	105	92	91
2.30 p. m.	114	99	97
3.30 p. m.	116	101	99
4.30 a. m.	118	103	101
5.30 p. m.	120	106	103
7.00 p. m.	122	109	106
8.30 p. m.	120	111	109
9.30 p. m.	122	112	110
9.00 a. m. 7-8-12	127	118	117
11.00 p. m.	129	119	118
12.00 m.	132	120	119
2.00 p. m.	133	121	120
4.00 p. m.	138	122	122
5.30 p. m.	138	124	122

Location of Thermometers

No. 1. Hanging in open 5 feet high, 12 feet from steam pipes.
No. 2. In flour in conveyor near floor, 12 feet from steam pipes.
No. 3. In flour in conveyor near floor, 12 feet from steam pipes.
Results: One hundred per cent of the insects were killed.

HUNTER MILLING COMPANY, WELLINGTON, KANSAS.

Capacity of mill, 1,000 barrels.
Building, brick.
Date of heating, July 21, 1912.
Character of day, partly cloudy and calm.
Outside maximum temperature, 97 degrees.
Outside minimum temperature, 74 degrees.
Heating system, steam pipes along wall and a few radiators.
Steam pressure maintained during the heating, about 100 pounds.

Basement

Capacity of floor 33,790 cu. ft. Amount of radiation 1,020 sq. ft.

READING OF THERMOMETERS

Time of day	Thermometers			
	No. 1	No. 2	No. 3	No. 4
	Degrees	Degrees	Degrees	Degrees
8.00 a. m.	96	128	98	98
10.00 a. m.	97	134	104	98
12.00 m.	100	136	105	98
2.00 p. m.	102	136	107	102
4.00 p. m.	104	138	108	106
6.00 p. m.	103	140	109	109
8.00 p. m.	103	143	109	109
10.30 p. m.	102	145	113	109

Location of Thermometers

No. 1. In flour in elevator boot resting on floor 5 feet from steam pipes.
No. 2. Hanging in open 6 feet high, 10 feet from steam pipes.
No. 3. In flour in elevator boot resting on floor 15 feet from steam pipes.
No. 4. In flour in elevator boot resting on floor 10 feet from steam pipes.
Result: Killing temperatures were not reached in elevator boots resting on the concrete floor.

First Floor

Capacity of floor, 40,040 cu. ft. Amount of radiation 780 sq. ft.

READING OF THERMOMETERS

Time of day	Thermometers		
	No. 1	No. 2	No. 3
	Degrees	Degrees	Degrees
8.00 a. m.	130	121	97
10.00 a. m.	138	123	100
12.00 m.	140	123	102
2.00 p. m.	140	124	108
4.00 p. m.	142	125	111
8.00 p. m.	143	127	113
10.30 p. m.	146	131	119

Location of Thermometers

No. 1. Hanging in open 6 feet high, 15 feet from steam pipes.
No. 2. In flour in roll, 20 feet from steam pipes.
No. 3. In flour in roll in cleaning room, 5 feet from radiator.
Result: One hundred per cent of the insects were killed.

Second Floor

Capacity of floor, 43,120 cu. ft. Amount of Radiation 800 sq. ft.

READING OF THERMOMETERS

Time of day	Thermometers		
	No. 1	No. 2	No. 3
	Degrees	Degrees	Degrees
8.00 a. m.	137	112	110
10.00 a. m.	144	119	113
12.00 m.	147	122	115
2.00 p. m.	151	127	121
4.00 p. m.	153	130	124
6.00 p. m.	153	128	126
8.00 p. m.	154	128	128
10 30 p. m.	156	130	129

Location of Thermometers

No. 1. Hanging in open 6 feet high, 15 feet from steam pipes.
No. 2. In flour in bottom of elevator boot, 15 feet from steam pipes.
No. 3. In flour on bolting cloth in reel, 12 feet from radiation (cleaning room).
Result: One hundred per cent of the insects were killed.

Third Floor

Capacity of floor, 43,120 cu. ft. Amount of radiation 900 sq. ft.

READING OF THERMOMETERS

Time of day	Thermometers		
	No. 1	No. 2	No. 3
	Degrees	Degrees	Degrees
8.00 a. m.	120	108	116
10.00 a. m.	126	114	121
12.00 m.	131	116	125
2.00 p. m.	136	120	130
4.00 p. m.	138	123	132
6.00 p. m.	139	124	134
8.00 p. m.	141	127	136
10.30 p. m.	142	129	138

Location of Thermometers

No. 1. Hanging in open 5 feet high, 12 feet from steam pipes.
No. 2. In flour in conveyor 14 feet from steam pipes.
No. 3. Hanging in open 5 feet high, 10 feet from radiator (cleaning room)
Result: One hundred per cent of the insects were killed.

TEXAS

Capacity of floor, 5,100 cu. ft. Amount of radiation, none.

READING OF THERMOMETERS

Time of day	Thermometers	
	No. 1	No. 2
	Degrees	Degrees
8.00 a. m.	121	109
10.00 a. m.	129	113
12.00 m.	134	117
2.00 p. m.	138	121
4.00 p. m.	141	124
6.00 p. m.	141	126
8.00 p. m.	141	128
10.30 p. m.	141	130

Location of Thermometers

No. 1. Hanging in open 6 feet high.
No. 2. In flour in conveyor near floor.
Result: One hundred per cent of the insects were killed.

INTER-OCEAN MILLS, TOPEKA, KANSAS.

Capacity of mill, 1,000 barrels.
Building, frame.
Date of heating, July 28, 1912.
Character of day, partly cloudy and light breeze.
Outside maximum temperature, 95 degrees.
Outside minimum temperature, 72 degrees.
Heating system, steam pipes along the wall.
Steam pressure maintained during the heating, about 80 pounds.

First Floor

Capacity of floor, 34,790 cu. ft. Amount of radiation, 262 sq. ft.

READING OF THERMOMETERS

Time of day	Thermometers					
	No. 1	No. 2	No. 3	No. 4	No. 5	No. 6
	Degrees	Degrees	Degrees	Degrees	Degrees	Degrees
8.00 a. m.	98	96	105	90		
10.00 a. m.	104	101	109	94	96	110
12.00 m.	110	106	108	97	104	113
2.00 p. m.	114	111	108	102	105	117
4.00 p. m.	118	115	110	107	108	120
6.00 p. m.	120	116	110	110	110	122
8.00 p. m.	121	117	112	113	112	123
9.30 p. m.	121	118	113	114	112	126

Location of Thermometers

No. 1. Hanging in open 5 feet high, 15 feet from steam pipes.
No. 2. Hanging in open 5 feet high, 18 feet from steam pipes.
No. 3. Resting on roll, 12 feet from steam pipes.
No. 4. In two inches of flour near floor, 5 feet from steam pipes.
No. 5. In flour in conveyor near floor 20 feet from steam pipes.
No. 6. Hanging in open 6 feet high, 20 feet from steam pipes.
Results: Ninety to ninety-five per cent of the insects were killed.

Second Floor

Capacity of floor, 38,269 cu. ft. Amount of radiation 190 sq. ft.

READING OF THERMOMETERS

Time of day	Thermometers					
	No. 1	No. 2	No. 3	No. 4	No. 5	No. 6
	Degrees	Degrees	Degrees	Degrees	Degrees	Degrees
8.00 a. m.	96	94	93	92		
10.00 a. m.	102	100	93	94	120	94
12.00 m.	108	104	95	99	128	97
2.00 p. m.	114	112	99	104	134	100
4.00 p. m.	118	115	103	107	139	106
6.00 p. m.	120	118	106	108	142	106
8.00 p. m.	122	118	110	110	143	108
9.30 p. m.	122	119	110	112	144	110

Location of Thermometers

No. 1. Hanging in open 5 feet high, 22 feet from steam pipes.
No. 2. Hanging in open 5 feet high, 18 feet from steam pipes.
No. 3. In three inches of bran near floor, 5 feet from steam pipes.
No. 4. In flour in elevator boot resting on floor, 17 feet from steam pipes.
No. 5. In oven in laboratory 5 feet high and three feet from steam pipes.
No. 6. In flour in elevator boot resting on floor, 30 feet from steam pipes.
Result: Ninety-five to one hundred per cent of insects were killed.

Third Floor

Capacity of floor, 49,375 cu. ft. Amount of radiation 267 sq. ft.

READING OF THERMOMETERS

Time of Day	Thermometers					
	No. 1	No. 2	No. 3	No. 4	No. 5	No. 6
	Degrees	Degrees	Degrees	Degrees	Degrees	Degrees
8.00 a. m.	98	95	94	96		
10.00 a. m.	104	101	100	98	96	102
12.00 m.	109	106	104	104	100	99
2.00 p. m.	115	112	108	108	104	103
4.00 p. m.	120	117	112	112	108	108
6.00 p. m.	124	121	116	116	112	112
8.00 p. m.	126	123	119	118	114	115
9.30 p. m.	127	124	120	122	116	114

Location of Thermometers

No. 1. Hanging in open, 5 feet high, 22 feet from steam pipes.
No. 2. Hanging in open 5 feet high, 20 feet from steam pipes.
No. 3. In flour in conveyor 6 feet high, 8 feet from steam pipes.
No. 4. In flour in purifier 4 feet high, 13 feet from steam pipes.
No. 5. In flour in elevator boot resting on floor 4 feet from steam pipes.
No. 6. In flour in conveyor near floor, 11 feet from steam pipes.
Results: One hundred per cent of the insects were killed.

Fourth Floor

Capacity of floor (including deck) 69,580 cu. ft. Amount of radiation 310 sq. ft.

READING OF THERMOMETERS

Time of Day	Thermometers					
	No. 1	No. 2	No. 3	No. 4	No. 5	No. 6
	Degrees	Degrees	Degrees	Degrees	Degrees	Degrees
9.00 a. m.	101	98	93	94	97	
10.00 a. m.	103	100	95	96	92	
12.00 m.	110	107	102	100	98	
2.00 p. m.	116	114	107	102	100	
4.00 p. m.	122	120	113	106	105	
6.00 p. m.	126	123	116	110	109	
8.00 p. m.	126	123	118	115	113	
9.30 p. m.	127	124	118	114	113	

Location of Thermometers

No. 1. Hanging in open 5 feet high, 26 feet from steam pipes.
No. 2. Hanging in open 5 feet high, 28 feet from steam pipes.
No. 3. In flour in elevator boot 6 inches from floor, 24 feet from steam pipes.
No. 4. In flour in conveyor near floor, 13 feet from steam pipes.
No. 5. In flour in conveyor near floor, 22 feet from steam pipes.
Result: One hundred per cent of the insects were killed.

Deck (or fifth floor)

Capacity included in measurement of fourth floor. Amount of radiation none.

READING OF THERMOMETERS

Time of day	Thermometers	
	No. 1	No. 2
	Degrees	Degrees
9.00 a. m.	104	100
10.00 a. m.	106	99
12.00 m.	114	112
2.00 p. m.	122	113
4.00 p. m.	126	118
6.00 p. m.	128	123
8.00 p. m.	127	125
9.30 p. m.	127	126

Location of Thermometers

No. 1. Hanging in open 5 feet from floor.
No. 2. In flour in conveyor near floor.
Results: One hundred per cent of the insects were killed.

PRESIDENT W. D. HUNTER: Is there any discussion on this paper?

MR. F. L. WASHBURN: Mr. Dean states the matter correctly when he says that hydrocyanic acid gas does not penetrate well. In spite of this, however, it seems to be a very good remedy, although it is not perfect. I would like to ask Mr. Dean the cost of piping an average sized mill.

MR. G. A. DEAN: In case the mill is using steam power and there is no steam radiation in the mill, it would cost in a 1,000-barrel mill from $500 to $600 to install a good heating system. The installation can be done by the mill men. There should be sufficient radiation to heat the mill to a temperature of 70 degrees during winter weather.

MR. F. L. WASHBURN: Don't you think that the average millman would object to spending that much money?

MR. G. A. DEAN: Inasmuch as a mill with a capacity of from 600 to 1,000 barrels will have on an average more than $100,000 capital

invested, I can not believe there would be any objection to the expense, especially if they can count on the complete control of the infesting insects.

MR. F. L. WASHBURN: If a housekeeper, who is reasonably clean, finds insects in the flour should not the blame in eight cases out of ten be placed on the mill from which the flour came?

MR. G. A. DEAN: In nine cases out of ten the infestation can be traced either to the mill or the grocery warehouse in which the flour has been stored.

MR. WILMON NEWELL: At what temperature will snout beetles in flour mills be destroyed?

MR. G. A. DEAN: They cannot stand a temperature of 119 degrees for more than two or three minutes. Of course, snout beetles are not serious pests in flour mills. However, in our heating of mills we have often noticed that they are all killed in those parts of the mill near the intake of the grain, which are about the only places where they are found.

MR. WILMON NEWELL: I asked the question because there are often large numbers of these insects in rice mills and the method of destroying them with heat would, I think, be of value. The injury caused by insects to stored rice is so great that the owners would not hesitate to spend a thousand dollars a season to destroy them.

Mr. W. H. GOODWIN: I think there is an important point which Mr. Dean did not mention and that is that it is best to begin heating the mill in the evening. By beginning the work at this time a fatal temperature is reached the next day, usually between 10 and 11 o'clock. One trouble that I have found is that it is almost impossible to maintain a high temperature after 5 or 6 o'clock in the evening owing to the gradual decrease in the temperature outside. This statement applies especially to conditions in Ohio where the ranges of temperature between afternoon and midnight are often very great.

MR. F. L. WASHBURN: I should like to ask Mr. Goodwin to express his opinion on the value of hydrocyanic acid gas.

Mr. W. H. GOODWIN: I believe hydrocyanic acid gas is of little practical value as a mill fumigant. In all my experiences with this gas in fumigating mills I have not had one perfectly effective result. In every case enough insects survived to reinfest the mill. The gas seems to condense so rapidly that it fails to be effective and the insects are either uninjured or recover rapidly after being subjected to fumigation.

MR. T. J. HEADLEE: In regard to the effect of high temperatures on insect life I desire to report that in the past two or three months

we have experimented with the leather beetle, *Dermestes vulpinus* Fab., and found that 125 degrees F. killed the insects without harm to the books which they were infesting.

MR. W. E. BRITTON: Can insects be destroyed in warehouses where seeds and grains are kept by using heat?

MR. G. A. DEAN: I would not recommend heat for killing insects infesting stored seeds and grain. In case they are stored in small quantities, the heat method would be entirely satisfactory, but if stored in large quantities it would require too much heat in order to penetrate to the center of the bins. The germination of the grain next to the heat would be injured and perhaps the gluten qualities. We have one or two mills that are planning to heat their grain in their elevators by passing it through a hot-air blast. I do not advocate heat for destroying pests in seed storehouses and grain elevators.

PRESIDENT W. D. HUNTER: I will now call for the paper by Mr. Newell, entitled "Notes on the Rice Water Weevil and its Control."

NOTES ON THE RICE WATER WEEVIL (LISSORHOPTRUS SIMPLEX SAY), AND ITS CONTROL

By WILMON NEWELL, *College Station, Texas*

The observations here recorded were made by the writer during the summer of 1909, while employed as entomologist of the Louisiana Experiment Stations, and a rather comprehensive report on the investigation was submitted to that Station in February, 1910. Contrary to expectations, it was not published. While a few workers have had access to my unpublished report and notes—and have used them more freely than professional courtesy would sanction—I nevertheless deem the records of sufficient importance to justify their presentation in condensed form before this Association.

Lissorhoptrus simplex is generally distributed, and generally destructive, over the entire rice-growing belt of the South. Thus far the only literature of importance dealing with the insect from an economic standpoint is the article by Doctors Riley and Howard in the Report of the Commissioner of Agriculture for 1881 and 1882, pp. 130–133. In this paper Doctor Howard gave a full account of his investigation of the pest near Savannah, Ga., and described control measures which have been followed, without improvement, to the present time.

In 1906 Mr. W. D. Pierce made mention of injury to rice by this species at Beaumont, Texas, in 1904.[1]

[1] Ann. Rept. Neb. Board of Agr. for 1906–'07, p. 265.

HABITS OF THE ADULTS. Upon undertaking field investigations in the spring of 1909, I visited various rice-growing localities in search of the insects, but did not find adults in sufficient numbers for satisfactory observation until June 3, on which date I visited a plantation three miles north of Lake Arthur, La. Here I found the adults very abundant in a field of Japan rice about eight inches in height. The irrigating water had been admitted to this field for the first time on June 1, just two days before my arrival and it had not yet reached the higher portions of the field. Here was an average of at least one weevil to every five or six rice plants, but none were found in rice which the water had not yet reached and no larvæ to speak of could be found on the roots of older rice. Some of the adults were swimming about, others were mating and the majority were feeding on the rice leaves.

The weevils are rather sluggish when out of the water, crawling slowly about the leaves of the rice. They can be picked up readily in one's fingers and frequently when touched they will play possum, or "sull," and fall off into the water where they either swim away or continue to "sull" and float on the surface. They cannot be made to take flight, even by throwing them into the air. They swim with great facility and considerable speed, either on the surface of the water or below it, and they apparently find swimming a more convenient means of traveling from one rice plant to another than flying. That they do fly, however, with ease, is shown by their night flights to brilliant lights and doubtless their principal, or sole, means of dissemination from field to field is also by flight.

Feeding Habits. Both the males and females feed upon the rice in an interesting way. The weevil takes a position on the upper surface of the leaf with body parallel to its main axis. The mandibles tear up the epidermis and the operation is assisted by the beak, which is used to push and lift, much as a hog uses its nose for rooting. As feeding progresses the weevil moves forward, feeding, usually, towards the apex of the leaf and makes a feeding scar about as wide as the spread of the mandibles and from 1-16 of an inch to two or more inches in length, depending on the length of time the individual is engaged in feeding. The mandibles do not pierce through the leaf but remove only the epidermis, "skeletonizing" the leaf at the point of feeding. As the leaf grows, or is whipped about by the wind, the skeletonized portion breaks through, making an oval or long slit in the rice blade.

It seems to make no difference, on a reasonably warm day, whether the weevils feed in the sun or in the shade, they being found feeding indiscriminately in both situations. When the day is extremely hot and the sun bright, the weevils show some disposition to avoid the

hottest situations. Thus on June 4, at Crowley, I observed that a much smaller proportion of the weevils were in direct sunlight than at Lake Arthur. When it is hot, also, more of the weevils are found resting along the stems and a larger proportion rest and swim in the water and under its surface.

Feeding is not confined entirely to the leaves. A number of adults were observed to make punctures in the main stem of the rice plant below the water surface. I am satisfied that all weevils observed feeding in this way were females, though the distinction between the two sexes in the field is rather difficult and uncertain except when they are observed *in coitu*. The injury made by the feeding below the water line is quite distinct from that done to the leaves above water. In the former case distinct punctures are made with the beak, not unlike the punctures made in cotton squares by the boll weevil.

Host Plants. Cultivated rice is the preferred host and food plant, and but little difference is noted in choice between Honduras and Japanese types. In general, it may be said that the adults prefer to feed on young plants, rather than on those of advanced size. Infestation of the rice field by the adults is invariably co-incident with the first flooding.

Doctor Howard, in the article referred to, recorded several plants which were fed upon by the adults, particularly wild rice, bulrush, water lily and spatter-dock.

In the course of my Louisiana observations, I found but two food plants and but one true host plant, other than cultivated rice. Wild rice, *Zizania aquatica*, did not, however, come under my observation, and it is to be expected that this is a true host plant.

On June 3, at Lake Arthur, I found the adult weevils feeding as freely upon the leaves of *Paspalum membranaceum* Walt. as upon the rice leaves, with which they were interspersed. The same habit was subsequently observed in all infested fields. Upon another *Paspalum* the adults fed as freely as upon *P. membranaceum* and on June 29 this *Paspalum*, growing in isolation from rice, was found to have its roots heavily infested with the water-weevil larvæ. This *Paspalum* was never positively identified and while apparently different in habit of growth from *membranaceum*, it may possibly be a variety of that species. It is about the first grass to begin growth in spring, occupying drainage ditches, shallow ponds and all places where shallow water is available. It was noticed growing abundantly in the street ditches of Crowley, La., in the spring of 1909. At that time I did not suspicion it of being a host plant of the water-weevil and its roots were not examined for the larvæ.

Attraction to Lights. The adults fly readily to artificial light of all

kinds, especially upon dark, warm nights. Thus on the night of June 4, at Crowley, La., they flew into all rooms where there was any light at all and were so numerous in the hotel bed rooms as to be a nuisance. Going upon the streets, I found them even more abundant and from the plate glass windows of business houses raked them up by hundreds and thousands. It was just at this time that the adults were entering the fields of young rice and there feeding and mating. It seems hardly possible that the thousands of weevils flying to the lights could have been only males and spent females. Weevils captured at the lights and confined in test tubes mated freely. It therefore seems not improbable that lamp trapping just before or during oviposition would possess value as a remedial measure.

Mating. The adult weevils are very precocious and mate at any and all opportunities. Mating takes place, for the most part, on the rice leaves above the water, where the adults are feeding. The mating is done after the usual fashion and frequently two males will be seen attempting to mate with a single female. The males appear to be the more numerous. If violently disturbed the pairs separate, but with gentle handling will not. In one case a pair was observed to remain *in coitu* for eight minutes. When confined in test tubes mating takes place immediately and will occur even after the weevils have been confined for several days. Adults collected around bright lights pair freely.

Difference in Sexes. By observing the weevils *in coitu* in the field it was noticed that, as a general rule, the females were a trifle larger than the males and the dark (or black) area upon the back was more distinct in the case of females than in the males. This difference in coloration is observable only when the insects are submerged and alive. I do not think this character can be made use of at all in separating the sexes when observing dried specimens.

At my request, Mr. W. D. Pierce, of the Bureau of Entomology, made a very close examination of males and females for secondary sexual characters and he was able to determine that in the female the scrobe on the beak, into which the scape of the antenna fits, is slightly curved in female specimens and practically straight in the case of the males. Owing to the natural curvature of the beak this character, while apparently constant, is one difficult to recognize with certainty.

Egg. Obtained by dissection of the female, the egg is found to be pure white, cylindrical, slightly curved and length about five times the diameter. It is barely visible to the naked eye, but can be plainly seen under a half-inch lens. The females have eggs, apparently well developed, in their abdomens at time of mating. I have had no diffi-

culty in taking full-sized eggs from females secured in the act of mating and dissected on the spot.

LARVA. The larvæ of the rice water-weevil are familiarly known to the planters as "rice maggots" and but few are familiar with the adult stage of the insect.

The larvæ eat off the small, tender roots and rootlets and injure the larger, older roots by gnawing into them, or even by eating out a cavity within the root amply large enough to contain the larva itself. Where the root is merely gnawed and not entered, a scar is left which is quite characteristic and which remains visible, probably, until the root dies and decays.

The larvæ are found most abundant where the individual rice plants are smaller and of a yellowish cast, instead of a bright, dark green. When as many as 4 to 8 larvæ (or sometimes 10 to 12) are found on the roots of each plant, the latter will be found to have a yellowish, sickly look, with some of the lower leaves discolored and dead. Plants which have their roots heavily infested come up, when pulled, very easily, in marked contrast to the difficulty experienced in trying to pull up healthy, non-infested plants.

Infested plants are constantly trying to overcome the injury by putting out new rootlets, but as long as the infestation remains heavy these rootlets are in turn destroyed. It is by means of these rootlets that the plants "recover" from the attack, in the language of the rice growers. The plant proper does not really recuperate, however, until the majority of the larvæ have reached maturity and their injury to the rootlets comes to an end. Even in the case of marked "recovery" there can be no doubt but what the productive capacity of the individual plant is severely curtailed.

DURATION OF GENERATIONS. As all my efforts to get the weevils to oviposit in captivity were futile, I could only approximate the duration of larval life by deduction from field conditions.

At the time adult weevils were so abundant in small Japan rice at Lake Arthur on June 3, I examined a field of older Japan rice adjacent. While the adult weevils were very abundant in the small rice, just flooded, they were extremely scarce in the older Japan. A long examination brought to light three partially grown larvæ on the roots of the older Japan, these larvæ being possibly referable to *L. simplex*. A field of early-planted Honduras rice, also near at hand, showed no adult weevils and no root infestation. The roots of both the large Japan and the large Honduras lacked, absolutely, the characteristic feeding scars which are left by the water-weevil larvæ. From these conditions it appeared that the weevils in the younger Japan rice were the ones which would deposit eggs for the first generation on rice.

The great abundance of adults at this time (June 3) seemed to preclude their being hibernated individuals. As stated above, *Paspalum* was shown to be a true host plant and was abundant from very early spring. It seems safe to conclude that the first generation of larvæ are produced upon the roots of *Paspalum* and perhaps other native plants, and that the weevils maturing from these are the ones to infest the young rice in May and early June. The field of rice which was just being flooded, and being occupied by adults for the first time on June 3, was again examined on June 29. At the latter date adults were very scarce but larvæ were found in abundance at the rice roots. The larvæ were all of about the same size and apparently up to maximum size. Some of these larvæ were kept on roots of live rice in cages as late as July 15, by which time they had neither increased in size nor changed to pupæ.

From this data we conclude that from 35 to 45 days elapse from deposition of the egg until completion of the larval stage. I was unable to determine the duration of the pupal stage.

It is not impossible that a third generation is produced upon native host plants, following maturity of the generation on cultivated rice.

CONTROL MEASURES. The only control measure followed to any extent during the past thirty years has consisted in drawing off the irrigating water in an attempt to destroy the larvæ. Among the rice growers themselves there is great diversity of opinion as to the efficiency of this plan. Experienced growers claim full success from the method, while others, equally as experienced, decry it as a dismal failure.

The writer believes that he was the first to detect the surprisingly simple explanation of these diverse results. Briefly stated, this explanation is as follows:

If the injury by the larvæ is in its incipiency and only a small proportion of the roots has been severed, drawing off the water for a reasonable time will destroy the larvæ and, if replaced at the proper time, will not perceptibly interfere with the growth of the plants.

On the other hand, if injury by the weevil larvæ has reached the point where practically all roots are severed, drawing off the water cannot result otherwise than disastrously to the plants for, with no root system except a few small rootlets at the crown, the plants have no way of getting sufficient moisture to continue growth. In such cases injury from drying occurs, far more severe, ordinarily, than the injury done by the larvæ when the water is left on. My examination of a large number of fields in all cases confirmed this explanation.

Every rice grower should be able to distinguish the degree of injury to the plants and determine therefrom whether the water should be

drawn off or whether it should be deepened. In the beginning of injury by the larvæ, judicious removal of the water, and reflooding at the proper time, should be followed. When injury has reached its maximum, removal of the water is disastrous and under such conditions the fields should be kept well flooded.

It should be noted, however, that while excessive flooding may be necessary at times to partially save injured fields, the practice itself does not destroy any of the insects and a continuation of the practice can hardly result otherwise than in a steadily increasing infestation from year to year.

Possibility of Poisoning the Weevils. Mention has been made above of the manner in which the adults feed upon the rice leaves before and during the period of oviposition. This would suggest the possibility of destroying them with arsenical poisons. The water-weevil is, in fact, more of a surface feeder than the plum curculio or boll weevil and some measure of success has attended the use of arsenicals against the latter insects. The ordinary spraying machinery could not be used in a flooded field, but there appears to be no good reason why a powdered arsenical, such as powdered arsenate of lead, could not be distributed from the levees with hand dust-sprayers, advantage being taken of prevailing breezes to distribute it over and across the "cuts." Consideration would of course have to be given to the possibility of the water carrying sufficient of the poison, after leaving the field, to be dangerous to stock.

PRESIDENT W. D. HUNTER: As there is no discussion of this paper I will now call for the paper by Mr. Parrott on "New Destructive Insects in New York."

NEW DESTRUCTIVE INSECTS IN NEW YORK

By P. J. PARROTT

The agricultural interests of the State of New York sustained large losses during 1912 by the depredations of insects. In variety of species and extent of damage the record has been an unusual one, and in my opinion has not been equalled for many years. While noting the destructive work of the common pests familiar to most entomologists, one also could hardly fail to be impressed with the number of comparatively new insects that came to the front and which, judging from their behavior during this and recent years, are likely to demand serious consideration in the future. It is the purpose of this paper to give brief notes on some of the more important species which have lately attracted our attention.

THE PEAR THRIPS. At the last meeting of this Association mention was made of the occurrence and the destructive work of *Euthrips pyri* Daniel in orchards about Germantown. With the coöperation of Messrs. Blanch and Albright of the Division of Nursery Inspection, through the courtesy of Commissioner Calvin J. Huson, we have determined that the thrips ranges over the Hudson River Valley from Monsey near the New Jersey line to Ravena near Albany. While the insect has done quite a little damage in some orchards on the west side of the river, it has been much more destructive in the region on the east side, running from Hudson to Germantown. In western New York the insect has been found on apples and cherries about Geneva and on pears in the fruit belt running from Rochester to the Niagara River.

While the thrips attacks all of the important tree fruits, it seems to be especially injurious to pears, principally the varieties Kieffer, Seckel and Clapp Favorite. During the spring of 1912 the blighting of blossom clusters in some orchards was very severe and caused a great reduction in fruit yields. Apple trees, while visited by large numbers of the adults, suffered to a much less extent; but dwarfed and curled leaves and occasionally stunted fruits were observed in most orchards. The stems of sweet cherries were especially attractive to the adults for the deposition of the eggs, and they as a rule showed considerable scarification. The effects of this injury upon fruit yields has proven difficult to determine, but our observations this spring led us to believe that the wounding of the stems may cause quite a little loss by the premature dropping of the affected cherries.

The results from the second year's spraying experiments were very satisfactory, and we shall continue to encourage spraying as the most promising means of affording protection to orchards.

THE CHERRY SAWFLY LEAF-MINER. This insect has attracted the attention of cherry growers quite recently and its work has been very conspicuous in plantings about Geneva and Germantown. The pest attacks sour cherries, preferring the variety Morello. The injury is caused by the larvæ of the sawfly which mine the leaves. The attack commences on the edge of the leaf towards the stem. The young larva works along one side towards the apex of the leaf, the tunnel increasing in size with the progress of the insect. Upon reaching the tip of the leaf the grub reverses its course and works back towards the stem, consuming the remainder of the pulpy tissues between the main rib and the margin of the leaf. As a result the interior of the leaf is eaten, leaving the epidermis which turns brown and forms a large blister. These blisters are very conspicuous in the upper surfaces of the leaves. Oftentimes the whole leaf is mined, but usually

with most of the foliage only from one quarter to one half of the leaf is destroyed. The principal damage occurs during the last week of May and the early part of June or about one month before the harvesting of the fruit. The extent of the damage varies with the season and if new growth is not abundant the loss of leaves can hardly fail to affect the yield to an important degree. The sawfly proves to be a new species and it also constitutes the type of a new genus. It has been designated by Dr. A. D. MacGillivray as *Profenusa collaris*.

Polydrosus impressifrons Gyll. We have been watching this species with great interest for several years as its increasing numbers have led us to believe that it is going to develop to be of considerable economic importance. It has become so abundant that during the early summer it is not an uncommon experience to carry the beetles on one's clothes into the home or to observe them on the window screens of buildings. Our attention was first attracted to these insects by their work on young leaves of poplars and willows, and in recent years we have seen them on the foliage of roses, apples and pears. The numbers of the insects would at once suggest to one that they must be causing some harm, but aside from slight injuries to foliage we have never been able to determine just what damage the beetles were causing. During 1912 we observed for the first time an example of their destructive capacity. This was in a large block of willows (*Salix caprea*), grafted to New American, Rosemary and Kilmarnock varieties, which was seriously injured by the beetles feeding on the young buds of the grafts so that they failed to grow.

So far we have obtained very little information regarding the work of this species in its normal habitat for it does not seem to have attracted much attention in Europe aside from systematic workers. Schilsky says that it is quite common in Germany, and Zimmerman states that in Austria the beetles are not numerous enough to be destructive. Giard intimates that it is a common but not an important insect in Europe. It apparently prefers buds and tender leaves, a habit which is shared by many closely related species, as *Polydrosus micans* Sch., *P. mali* Fb., *P. sericeus* Gll., *Phyllobius viridicollis* Sch., *Ph. maculicornis* Germ., *Ph. pyri* L., *Ph. oblongus* L., *Ph. argentatus* L., and *Ph. calcaratus* Sch., which have been more closely studied in Europe. The fact that *impressifrons* is apparently of little significance abroad does not warrant the conclusion that it will prove of no importance in this country. In fact we believe that the beetles are already more numerous here than in Europe or more attention would surely have been given to the species.

Apple and Cherry Ermine Moths. At the twenty-second annual meeting of this Association mention was made of the importations of

Yponomeuta caterpillars in the United States in shipments of foreign nursery stock. Since the discovery of these insects special precautions have been taken by the agents of the Division of Nursery Inspection of the New York Department of Agriculture with plantations of imported seedlings, and during the past four years infested plants have been detected in thirteen localities in the state. According to the reports of the nursery inspectors over nine hundred colonies of caterpillars have been collected. From some of this material we have bred two species of moths—*Yponomeuta malinellus* Zell., which thrives largely on apple, and *Y. padellus* L., which is a more general feeder; showing preference for hawthorn, plum and cherry. Both species are common and destructive fruit pests in Europe.

Careful inspections of nursery plantations and the surroundings of nurseries indicate that these lepidopterons have not gained a footing in New York. In states where there has not been such inspection the danger that such has taken place is obviously great. With the ability of these insects to survive the conditions incidental to the importation of nursery stock from abroad and to escape ordinary nursery inspection, the wonder is that they have not before this succeeded in establishing themselves along the avenues of trade in America.

The False Tarnished Plant-Bug. During some seasons pears in New York are subject to a diseased condition, characterized by the cracking open of the skin in small spots and the formation of protruding granular areas. Fruits seriously affected are usually much deformed and undersized. The nature of the causal agent appears to have been little understood or not definitely known, although some writers have held that the tarnished plant bug (*Lygus pratensis* L.) is responsible for such injuries. Recent studies by us have shown that the scarring of the pears is due to the work of a closely-related species (*Lygus invitus* Say). The damage is done principally by the nymphs which attack both the fruit and foliage of pears. The same species also seeks grape blossoms and punctures the stems as well as the pedicels of the blossoms and fruits, causing imperfect clusters of grapes. In some orchards about Pavilion and Lockport this capsid has been responsible for losses in yields fully as large as those by the pear psylla, which is a great "bug-bear" to most pear growers in this state.

In recent years the work of various capsids on apple and pear fruits has been increasingly conspicuous. In addition to *L. invitus*, we have also observed the nymphs of *Campylomma verbasci* Meyer and *Paracalocoris colon* Say puncturing young pears soon after the dropping of blossoms. The red bugs (*Heterocordylus malinus* Reut. and *Lygidea mendax* Reut.) are doing considerable damage in many apple orchards

by destroying young apples or causing the fruit to be deformed so that it is unmarketable. The destructive work of these insects during 1912 would indicate that they are going to become a serious item for economic consideration.

THE GIPSY MOTH. Last in this list of the new destructive insects of New York and more important than all is the Gipsy Moth (*Porthetria dispar* L.) which was discovered by W. J. Schoene of the Geneva Experiment Station on June 22, 1912. An announcement of the occurrence of this insect in this state and some of the circumstances of the infestation were given in the JOURNAL OF ECONOMIC ENTOMOLOGY, Vol. 5, p. 371. It now appears that this pest was largely confined to a few old apple trees in the rear of several residences. No efforts have been spared by the agents of the New York Department of Agriculture to suppress the pest, and it is expected that with the vigorous measures that are being employed it should be exterminated. According to Mr. G. G. Atwood of the Bureau of Horticulture and Nursery Inspection, the presence of this species in the residential section of this city appears to be due to importations of nursery stock which was unpacked in the immediate vicinity of the fruit trees. According to him the infestation was probably started by not more than one mass of eggs, and is not more than three years old. He reports that about eighteen hundred caterpillars, five hundred pupae or pupal cases and twenty moths were collected and destroyed. In the discovery, for the first time, of a colony of the Gipsy Moth in the western portion of the State and not in the region adjoining Massachusetts, that which was little expected has happened. One may well wonder if the pest does not exist in other localities and has so far escaped attention because of the unfamiliarity of local observers with its appearance and importance.

PRESIDENT W. D. HUNTER: This paper is now open for discussion.

MR. H. J. QUAYLE: I am much interested in that part of the paper referring to the pear thrips. I would like to ask what experiments have been carried on for the control of this insect.

MR. P. J. PARROTT: In reply I will say that at the New York Experiment Station, we have been conducting experiments, and in this work we have used Black-Leaf 40 with soap or kerosene emulsion, making two sprays from the time the buds burst until the blossom clusters open. In New York State the spring advances rapidly and the buds open very quickly—much more so, I am informed, than in California. My impression is that this problem will be a more simple one than in that state. Spraying for the pest is, nevertheless, expen-

sive, and we are now trying to work out a spraying schedule for pears to control the thrips, San José scale, and Psylla, and simplify the work of spraying.

MR. W. W. YOTHERS: Have you used distillate oil in place of kerosene emulsion?

MR. P. J. PARROTT: No; we have used kerosene emulsion exclusively—made according to the Government formula.

MR. T. J. HEADLEE: For the sake of more efficient inspection of nursery stock I would like to ask how the ermine moth may be recognized, as it comes in on nursery stock.

MR. P. J. PARROTT: The moths have been imported into this country on seedling apple and cherry trees. The egg masses resemble somewhat immature lecanium scale and they are usually found near the buds. The New York Inspectors have been carefully instructed as to how to make examinations in order to detect them, but I do not believe it is possible for them to find all the egg masses that come in the shipments. The best way to control this pest is by inspecting the plantations of nursery stock during the latter part of May and early June, and destroying the plants that show the webs or tents of the insect.

MR. H. A. GOSSARD: What I wish to say at this time does not perhaps relate to the interesting paper presented by Mr. Parrott, but it is suggested by it. It was formerly the custom of the U. S. Bureau of Entomology to publish, in the Yearbook of the Department of Agriculture, a review of the more important insect phenomena for the year, so that by reading it one could obtain in a short time a bird's-eye-view of all the important economic happenings in entomology for the whole country for the season. I presume that the abridgment of the Yearbook has compelled the Bureau to drop this feature, although I for one believe this was one of the most important parts of the Yearbook. At present we are obliged to read a large number of State reports and papers similar to the one just given, in order to get this information. The Bureau of Entomology is better fitted than any other agency to furnish this information and I believe that this Association should take the matter up and see if it will not be possible to have these reviews furnished, and published in the JOURNAL OF ECONOMIC ENTOMOLOGY.

MR. F. L. WASHBURN: I believe this idea is a very good one, but would suggest that the subject be referred to the Committee on Resolutions for consideration and action.

PRESIDENT W. D. HUNTER: If there is no objection this matter will be so referred.

Adjournment.

Morning session, Thursday, January 2, 10 a. m.

PRESIDENT W. D. HUNTER called first vice-president Headlee to preside.

VICE-PRESIDENT HEADLEE: We will now take up the discussion of the Presidential address.

MR. R. A. COOLEY: Mr. Chairman, I am very sure that we all found the President's address of much interest. It showed evidence of thoroughness and a grasp of the growing question of medical entomology. I might predict that our present Association will soon be divided into two sections; one on agricultural entomology; and one on medical entomology. I believe that this will be the natural course of events and that workers in the latter branch will turn back in years to come and see that this meeting formed the corner stone for such an organization. I was particularly interested in the President's outline of the functions of medical entomology. Many of us who do work of this sort will find questions arising in relation to this and other related branches of science, and we can always turn to this address as a logical statement of the facts. Figures based on such investigations as those outlined, must naturally convince us that we have in medical entomology a subject which will soon develop into one of the main branches of economic entomology. I feel sure that we as a profession should feel very grateful for this paper which will doubtless become a classic.

MR. W. E. BRITTON: I feel very grateful to Mr. Hunter for presenting such an interesting paper. I wish that some arrangement might be made for having a large number of reprints made to be distributed throughout the country in libraries and journals, so that it will have a wider distribution than if published in our journal alone; because I think that people are becoming much interested in papers of this sort. I would be very much pleased to see the paper distributed in this form. Again I wish to thank Mr. Hunter for his admirable address.

MR. T. B. SYMONS: Unfortunately, I was not able to hear the paper by Mr. Hunter, but we all appreciate this work. I have been thinking that possibly it might be well for this Association to have one joint session with Section K, and that this might bring us in closer touch with medical work which is being done. It seems to me that the closer we can coöperate along this line, the better it will be for all concerned.

VICE-PRESIDENT T. J. HEADLEE: I have seldom had the pleasure of listening to such a logical and interesting address as the one delivered by our President. It clearly shows that the time is at hand when medical entomology will be considered as important as agricultural entomology, and that perhaps in the future it may even surpass

it in its hold on the attention of our people. States like New Jersey in which the urban population is a very large part of the whole and in which farming land is being rapidly transformed into suburban residence property, medical entomology is particularly needed.

If there is no further discussion I will now pass the chairmanship over to President W. D. Hunter.

PRESIDENT W. D. HUNTER: The first paper of this session will be presented by Mr. Henry H. P. Severin on "The Mediterranean Fruit Fly."

PRECAUTIONS TAKEN AND THE DANGER OF INTRODUCING THE MEDITERRANEAN FRUIT FLY (CERATITIS CAPITATA WIED.) INTO THE UNITED STATES

HENRY H. P. SEVERIN, *Honorary Fellow, University of Wisconsin*

CARGO: The chief dangers of introducing the Mediterranean fruit fly into the United States is through ships carrying cargo, ship stores, export fruit and baggage into our coast ports. With such a large coast line as we have on the western boundary of the United States dotted with harbors, it is interesting to know what precautions are taken to keep this serious pest out of California, Oregon and Washington. On the California coast every ship coming from a *foreign port* must first enter one of the five ports of entry, and report to the United States Customs. Each ship, upon its arrival at one of these ports of entry, finds in waiting, one or more horticultural quarantine officers who together with the customs' men examine the horticultural products on board and the baggage of the passengers. Each vessel upon its arrival, must furnish a manifest, itemizing all horticultural products carried in the vessel as freight and indicating the nature, extent and origin of such material. The inspector having this information some time in advance of the actual landing of such imports, can take proper precautions for their inspection, treatment and final disposition. Practically the only horticultural imports arriving from Honolulu to the ports of entry are pineapples, bananas and root crops, all other crops being quarantined against under the Plant Quarantine Act (Quarantine Notice No. 2).

One Californian, after having studied the fruit fly situation in the Hawaiian Islands on returning to San Francisco, observed that the steamer on which he was traveling docked just a half hour later than another which came from the Orient. He wondered how three (now six) horticultural quarantine officers could search a steamer thoroughly

in half an hour, and be ready to inspect the steamer on which he was traveling in so short a time. The first steamer came from the Orient via Honolulu and as soon as the federal health officer lowered the quarantine flag, one horticultural quarantine official and three or more customs' men boarded the ship which they met in the open sea in a launch and began to search the ship's stores, the steerage lockers, the steerage galleys, the forecastle galleys, etc. As this steamship sailed from a foreign port, and docked at San Francisco, forty or more customs' men began to search the travelers' baggage. Whenever these customs' men found a horticultural product of any kind they held the same until a quarantine officer examined it. The horticultural officers received a special manifest setting forth every article of horticultural product that was on the ship. The manifest was taken to the dock agent and the horticultural products were marked on this list and could not be removed from the dock until searched. One horticultural officer has boarded the next steamer and as it approaches the dock, the two remaining quarantine officers hurry to meet this steamer. This steamer happened to be sailing between two *domestic ports, i. e.*, Honolulu and San Francisco. The United States Customs' men do not search ships plying between domestic ports and the quarantine officers must, therefore, perform all of this work. There are two steamship companies running steamers between Honolulu and San Francisco and every one of these ships is absolutely dependent upon the quarantine officers for examination.

What about other ports along California, Oregon and Washington coasts where no quarantine is being maintained? Sailing vessels from Honolulu and other Hawaiian ports sail to California, Oregon, and Washington ports. And again, what about Australian steamers which stop at Honolulu and then proceed to Vancouver? Shipments by rail or by Pacific coasts steamers from these ports would be a constant danger of distributing infested fruit from the Hawaiian Islands. In connection with the oil ports in California the ship owners have issued an order to the captains of all their vessels on September 8, 1911, which reads as follows: "From now on it will be against the rules of this company for you or any of your crew to bring ashore any fruits that are put on board your vessels at Honolulu. Any infringement of this will mean expulsion." Under the Plant Quarantine Act it is unlawful for these sailing vessels to receive for transportation from Honolulu any quarantined fruits or vegetables. British Columbia has placed a complete quarantine against any kind of fruit from the Hawaiian Islands.

SHIPS' STORES: An arrangement has been made with ship owners that all fruits and vegetables purchased at Honolulu for ships' stores

should be thrown overboard before entering California water, *i. e.*, before or arriving at the three-mile limit. Even this is a dangerous method to pursue for Gurney of New South Wales immersed the Mediterranean fruit fly maggots in sea water for a period of forty-five hours and a large percentage of these maggots developed into adult flies. Notwithstanding the promises of ship owners that the remnants of all fruits and vegetables purchased at Honolulu for ships' stores should be thrown overboard before their vessels enter California waters, the quarantine officers, during the month of May, 1912, found living larvæ of the Mediterranean fruit fly and melon fly in eleven different instances in this class of stores on board ships arriving from Honolulu. The quarantine officers then threatened to hold at anchor, away from the docks, all ships arriving from infested ports until they were declared free from insect pests. The reaction of this stimulus brought about the desired effect for no more infested fruits or vegetables were found in the ships' stores on the Honolulian steamers since.

EXPORT FRUITS FROM THE HAWAIIAN ISLANDS: Let us take up next the danger of sending export fruits from the Hawaiian Islands into the United States. On June 24, 1911, California placed a quarantine against all Hawaiian fruits excepting pineapples and bananas. On October 1, 1912, the Plant Quarantine Act went into effect, the Secretary of Agriculture having followed the footsteps of California in quarantining all the Hawaiian fruits, except pineapples and bananas.

In the last number of the JOURNAL OF ECONOMIC ENTOMOLOGY No. 6, pages 443–451, we published a paper entitled, "Will the Mediterranean Fruit Fly (*Ceratitis capitata* Wied.) Breed in Bananas under Artificial and Field Conditions?" There is no question or doubt but that the Mediterranean fruit fly will occasionally breed in ripe and overripe bananas under Hawaiian conditions. The fruit fly was also bred from a half ripe banana under field conditions.

A number of entomologists have bred the Mediterranean fruit fly from pineapples and bananas under natural conditions. Kirk of New Zealand has actually bred the Mediterranean fruit fly from pineapples and bananas intercepted at the wharf. French of Victoria has also reared the pest from pineapples and bananas, and on many occasions he has proven "eggs to have been deposited in green bananas."

What precautions were taken at Honolulu to prevent the Mediterranean fruit fly from entering the United States through export pineapples and bananas? On March 1, 1912, the marketing division of Honolulu took entire control of shipping export fruits. An inspector was employed who visited the various banana plantations and inspected the bananas. He was not to pass bunches containing scale infested bananas nor ripe, partly ripe or injured bananas. The

bunches of bananas were marked in the field and later tagged, and arrangements were made with the steamship companies that no untagged fruits or vegetables were to be shipped to California. The material used in packing pineapples and bananas was changed from grass, in which there was a possible danger of the pest to pupate, to rice and excelsior. The wagons carrying the packed bananas were to be covered with canvass to prevent any maggots from dropping on the load while driving below fruit trees through the streets of Honolulu.

What precautions are taken at San Francisco regarding pineapples and bananas entering California from Honolulu? At a meeting of the California quarantine officials on June 7, 1912, it was decided to burn the wrapping material around bananas shipped from Honolulu, but whether this good intention is being carried out at present I am not able to state. All fresh pineapples destined for California points are fumigated heavily as a matter of insurance before they leave the dock. At San Francisco a man is especially detailed to make a thorough inspection of banana imports on the dock and to inspect fruits in the store-rooms of the commission districts.

With all the evidence showing that the Mediterranean fruit fly has been bred from pineapples and bananas, you may wonder why California did not follow the footsteps of British Columbia and place a complete quarantine against all Hawaiian fruits. At a meeting of the quarantine officials at Sacramento, the California representative who had been stationed in Honolulu admitted that California was taking *a chance in allowing pineapples and bananas to enter the state.* After discussing the fruit fly situation for six hours with the California quarantine officers, it was fully decided to put an absolute quarantine against the Hawaiian Islands. At a meeting of a fruit fly committee in connection with the California state fruit growers' convention held at Santa Barbara on June 13, 1912, this question was put to me, "If there is a choice between (1) a complete quarantine against the Hawaiian Islands and (2) to stop the inspection of baggage, which would you recommend on the strength of the greater danger of the Mediterranean fruit fly entering the state of California through these two sources?" I replied that the greater danger would rest in infested fruit being carried in the baggage.

BAGGAGE: The most dangerous loophole through which the Mediterranean fruit fly may gain entrance into the United States consists in the fact that the California quarantine officers have no legal right to search baggage. When a passenger at Honolulu goes aboard a steamer coming from a foreign port, his trunk is sealed at Honolulu and the customs' men do not search this sealed trunk at San Francisco, but only search his hand baggage. The United States Cus-

toms' men have no authority to search baggage on any steamer sailing between domestic ports, for instance, between Honolulu and San Francisco. As already stated there are two steamship companies which carry passengers on steamers sailing between the Hawaiian Islands and San Francisco. The horticultural quarantine officials search hand baggage of passengers traveling on these ships, and yet these officers have no national law to give them the power to do so. The privilege was acquired through the coöperation of these two steamship companies with the California quarantine department. On each ticket good for passage from Honolulu to San Francisco, an agreement is stamped whereby the purchaser of the ticket agrees to submit all of his baggage to the inspection of the horticultural officers before leaving the docks at San Francisco. This agreement went into effect on June 17, 1911.

When I arrived in San Francisco on June 6, 1912, from Honolulu on one of the steamers sailing between these domestic ports, all passengers' hand baggage was searched by the horticultural quarantine officers but not a single trunk was inspected by these officials. A passenger could have taken to any city in the United States, 350 pounds of Hawaiian grown fruit in his trunk, or even more if he cared to pay excess baggage. The greatest danger then, of introducing the pest into almost any place in the United States rests with the travelers, making a trip from the Hawaiian Islands to the United States and who may carry Hawaiian grown fruits in their trunks into California and out of this state. In most cases, fruit would be carried by passengers not familiar with the danger of introducing this pest but from reports that I have received in Honolulu, there are some people who have returned to Honolulu from the mainland and who delight to say they have "beaten" the horticultural quarantine officers and have taken fruit to their friends, or for their own use, in the United States. This of course, is second-hand data but Maskew, chief deputy quarantine officer of California, in his April report, 1912, writes, "In the matter of passengers' baggage, fruit fly material was detected and destroyed in fifteen instances among those arriving by the various lines during the month," from Honolulu.

In Honolulu an inspector visits the fruit markets daily and he is empowered to seize any fruit, melon or vegetable that is infested by the fruit fly and offered for sale. This reduces somewhat the danger that tourists, coming from the Orient and stopping for a day or two, will buy infested fruit during their stop-over; but this does not prevent travelers, who remain in the islands for some time, or individuals who live in Hawaii and occasionally visit the mainland, from buying infested fruits from peddlers. Every day a Chinaman carrying two large

baskets loaded with fruits and vegetables makes a house to house canvass and offers, often badly infested, fruit for sale. These Chinamen will take orders for large amounts of fruits and deliver the same to your door. How easy it would be for the unthinking, traveling public to buy fruit from these peddlers and pack the same in a trunk to take to their friends or for their own use on the mainland!

PRESIDENT W. D. HUNTER: Is there any discussion on this paper?

MR. C. L. MARLATT: I am very glad to have listened to Mr. Severin's paper and I think he is correct in many things that he has said, but he is a little behind the times as to some things and he is not altogether fair in speaking of control measures. I spent one month in Hawaii and during that time I was very busy seeing all that was possible of the fruit fly throughout the islands of Hawaii. Human effort is never perfect. Nursery stock is sent to every place in the United States and the success of the Federal Plant law depends on the individual inspectors. A law rests on the character of the individual who enforces it. The authorities in Honolulu have undoubtedly done the best they could. When I was there the city was as clean as a dollar and there was no affected fruit noticeable. It is true, there was not much fruit when I was there, and the season that Mr. Severin speaks of is the season when the fruit is most abundant, when hundreds of barrels fall from the trees every night and the conditions are necessarily at their worst. No doubt the conditions when Mr. Severin was there are correctly described but somewhat wrongly interpreted. The inspection at the San Francisco end is a further check, and the fruit is prohibited at British Columbia. The protection elsewhere along the coast is pretty good. If there is a single bad or broken fruit the inspectors at San Francisco reject it. You can find good and bad in any question, but in this instance the balance is distinctly on the right side. The experimental testing of food products is to be very carefully done, and if we find that there is danger from bananas the federal quarantine will be extended to this fruit. California has not been lenient in letting things in; she has rather gone to the other extreme and carried her quarantines beyond the actual needs. Bananas and pineapples are inspected now by federal officers in Hawaii, and that inspection is repeated at San Francisco. No doubt it is true that some officers have not been absolutely above suspicion, but that is one of the things we have to come in contact with always in human nature. The paper points out one side rather than the other. We are improving the situation as fast as we can, and I think the people who have been affected by this quarantine have accepted it with splendid spirit. There has not been a bit of hesitation in establishing safeguards, and

I think there is a good deal to be said in commendation. The work that Mr. Severin did is much to his credit, but you cannot blame people for resenting criticism when they are doing the best they can. I am sorry that Mr. Severin's work was interrupted. It was very interesting and has added much to our knowledge of the fly.

PRESIDENT W. D. HUNTER: The next paper will be presented by Mr. C. H. Hadley, Jr., on "A City's Attempt to Trap Brown-tail Moths."

A CITY'S ATTEMPT TO TRAP BROWN-TAIL MOTHS

By C. H. HADLEY, JR., *Durham, N. H.*

(Paper not received for publication.)

MR. F. L. WASHBURN: I should like to have you give some data on the relative number of male and female noctuid moths, which came to the lights.

MR. C. H. HADLEY, JR.: We secured no data on the number of noctuid moths.

MR. A. F. BURGESS: In connection with the data given in this paper I will say that during the summer of 1910 a series of experiments was conducted in Reading, Mass., for the purpose of determining the percentage of male and female brown-tail moths that could be trapped at arc lights. In all thirteen separate lights were used and the experiments were carried on throughout the month of July. A considerable variation occurs in the number of the sexes secured during different times in this month. In 1910 the first moths were caught July 1 and the last ones July 29. Over 78,000 were secured and these were preserved and carefully examined during the winter; 71 per cent. of the insects were males and of the females only 2/10 per cent. had deposited their eggs. At these trap-lights large numbers of other insects were secured. An interesting feature was that a very large percentage of the female tent caterpillar moths, that were secured in the traps, had already deposited their eggs. I cannot give the relative percentage of male and female noctuid moths which were obtained, although I think we have some data on this subject.

MR. P. J. PARROTT: Is this trap considered a promising method for general use?

MR. A. F. BURGESS: Most of the traps which we used consisted of a pan in which was placed water and a small amount of oil. The labor of cleaning these every day was considerable and we did not think they were a practical method of control.

PRESIDENT W. D. HUNTER: The next paper, "The Results of Experiments in Controlling the Gipsy Moth by Removing its Favorite Food Plants," will be read by Mr. A. F. Burgess.

RESULTS OF EXPERIMENTS IN CONTROLLING THE GIPSY MOTH BY REMOVING ITS FAVORITE FOOD PLANTS

By A. F. BURGESS and D. M. ROGERS, *Boston, Mass.*

For many years great effort has been made to bring to perfection the mechanical methods for controlling the gipsy moth. Aside from the work of introducing the parasitic and predatory enemies of this insect, experiments along the line of perfecting methods of control have occupied a great share of the attention of the government and state officials in charge of the moth work and of various investigators and observers connected with it. In the earlier writings concerning the feeding habits of gipsy moth caterpillars and in the experiments which were conducted to test their ability to feed on the foliage of the native tree growth of New England, the conclusion was reached that this insect was a general feeder and that practically all the trees or plants concerned would suffer severe injury on account of being defoliated by the larvæ. In fact, during the period when the territory in the suburbs of Boston was the worst infested, about the years 1904 to 1906, large woodland areas were completely defoliated owing to the enormous number and voracity of the caterpillars.

Early in 1907 it was noticed that in many places, where the gipsy moth defoliation had been severe, that the larvæ seemed to show some preference in the species of trees attacked. It was also observed that white and pitch pine did not appear to be severely defoliated unless they were growing in or near an area of hardwood trees. Realizing the importance of this matter Mr. A. H. Kirkland, then superintendent of the Moth Work for the state of Massachusetts, detailed Mr. F. H. Mosher to carry on a series of laboratory experiments to test the feeding of newly hatched gipsy moth caterpillars on pine foliage. These were carried on during the spring of 1907 and were repeated the following spring. Mr. Mosher failed to rear first stage caterpillars on this food. In the spring of 1908 an extensive field test was made, using a clear stand of about five acres of white pine growth in Arlington, Mass. This experiment was carried on coöperatively between the Massachusetts superintendent of Moth Work and Mr. D. M. Rogers of the U. S. Bureau of Entomology. The locality was badly infested and the trees on the border about 100 feet deep, were banded with tanglefoot in order to prevent caterpillars from crawling into the

area. No other treatment was applied and no injury resulted to the trees.

During the following two years observations were made on the feeding habits of the gipsy moth caterpillars by various observers, and in 1910, when bulletin No. 87 of the Bureau of Entomology was published, covering a report of the field work against the gipsy and brown-tail moths, enough information had been secured so that the authors felt warranted in making the following statements.

On page 14 it is stated that the gipsy moth has a varied list of food plants, "in fact, it will eat almost any kind of vegetation, although it seems to prefer the foliage of oaks, willows, and apple trees. Repeated observations have shown that the ash, juniper, and red cedar are practically immune from attack, while the maple is not injured to any great extent if more desirable food is within easy reach." As a result of these observations it was recommended, pages 73 and 74, that "owners of woodland on which the trees are of marketable size should cut the timber if the gipsy moth is prevalent in the region. Care should be taken in doing this work to cut out all poor and worthless trees, and if possible to leave for reforesting purposes, vigorous specimens of ash, maple, pine, or coniferous trees of which the insect is not especially fond and which can be protected with the least possible expense. The planting or preservation of ash and hickory is recommended as the wood is of high value and these trees are not subject to attack by the brown-tail moth. Planting pine or other coniferous trees for reforesting purposes is also advisable, as the region is suited to their growth and these can be protected from moth injury at slight expense. It is probable that many of the forests containing oak or other trees which are preferred by these insects must in time give way to species less subject to attack. In the meantime the owner should take advantage of the opportunity to harvest his merchantable trees that are susceptible to attack and foster the growth of other species that will not be destroyed."

After the publication of this bulletin more observations were made on the food plants of the gipsy moth and Mr. Rogers became so thoroughly convinced of the practical utility of eliminating the trees, which were most favored by this insect, that in the winter of 1910–11 much consideration was given to the subject by him and several experiments were carried on, on a large scale to determine what would happen if forest areas were thinned to solid blocks of species which had frequently been observed to withstand defoliation.

An area was selected near Chelmsford Center, Mass., where the tree growth was chiefly chestnut, with some gray birch and oak, and where the infestation was heavy. Seven acres were used for the

experiment. The oak and all other trees, except chestnut, and a few conifers, were removed and the brush and slash burned. This left a stand of chestnut trees averaging 35 to 45 feet in height, all of which were badly infested. No detailed observations were made during the early summer, but occasional visits by Mr. Rogers during the season failed to indicate any defoliation of the chestnut trees. Since that time the brush and sprouts have been allowed to grow and while the trees have not been injured by caterpillar feeding, the oak sprouts have furnished enough food so that the infestation is slightly greater than it was in the fall of 1911.

During the same winter another block of woodland in Methuen, Mass., covering about twenty-five acres, was thinned as an experiment. One section of this woodlot covering perhaps four acres consisted mainly of white pine with scattering oak trees and undergrowth; the balance consisting of red and white oak, gray and yellow birch and red maple. The latter species was particularly common on the low ground and in some parts of this area several small groups of hemlock trees were growing. The section where pine predominated was thinned to solid white pine growth, while in the oak and maple area all the oaks were cut except a few specimen trees. On the lower land all oaks and birches were removed leaving red maple, and in a few places hemlocks and an occasional pine. A part of the trees growing on the high ground was badly infested and the infestation decreased slightly on the lower ground where more maples were growing. In the spring of 1911 the trees on the higher area were banded with tanglefoot, where this lot joined a badly infested woodlot, but no other treatment was applied and no serious injury resulted except to some of the oaks. The infestation over the entire area decreased remarkably as a result of the thinning. This fall, 1912, practically all of the trees, except the oaks, are in good condition. A slight infestation can be found throughout the entire area but it is apparent that no injury to the trees is likely to result from it. This woodlot has been used as a pasture for cattle so that very little sprout growth exists.

In order to follow up the results of making experimental thinnings and to attempt to secure more information on this important phase of the gipsy moth work, as well as to obtain field data which could be used in connection with an extensive series of laboratory feeding experiments, which were made during the summer of 1912, a number of areas were thinned during the winter of 1911–12 under the direction of the writers.

In Hudson, Mass., an area of chestnut, maple, red and white oak, gray birch and ash, with various kinds of undergrowth which was slightly infested, was thinned to a chestnut stand and all specimens

of maple and ash were allowed to remain. On one side of the area large pines predominated which were mixed with gray birch and an occasional oak. The last two species were removed leaving a pine stand with an occasional maple, chestnut, or ash tree. The brush was cut over the entire area except the seedlings and sprouts of the same species as the trees left standing. No gipsy moth injury has been observed during the summer of 1912, frequent observations having been made by Mr. H. R. Gooch, who had charge of the thinning operations in this and several other selected areas. The infestation appears to be about the same as it was last year. Other areas have been thinned leaving solid pine and hemlock stands and no injury has resulted to the trees during the past summer. In one case a remarkable decrease in the number of egg clusters has been noted, while in the adjoining unthinned block a slight increase has been observed.

It is apparent that it will be necessary for a number of years to pass before the final results of this work can be given, but the information at hand is of such practical importance to owners of woodland that it seems well to make public the results that have been secured. In this connection it should be said that very thorough and detailed observations are being made, both in the field and by means of laboratory tests, to secure exact information on the feeding habits of gipsy moth caterpillars in each stage and on all the food plants which are common to New England. The data secured during the past summer are not yet ready for publication, but the results indicate that the oaks should be eliminated as rapidly as possible from our woodlands.

While they are the chief offenders they are not the only species that should be eliminated. Gray birch is a common species and is of low value as far as the wood is concerned. In some cases it is useful as a nurse crop for pine but its susceptibility to gipsy moth attack renders it a dangerous companion for the latter. Neglected or wild apple and willow trees should be destroyed as they furnish attractive food for the caterpillars. First stage gipsy moth caterpillars do not feed freely on pine or hemlock and the same is true in regard to some of our hardwood trees. In fact, it is exceptional for first stage caterpillars to grow and develop when their diet is confined to certain species. If half-grown or larger caterpillars feed on the same plants a large percentage of them will develop and if the same thing happens in the field where the infestation is at all severe, defoliation by the larger caterpillars often results to species which are not particularly favored as food by the younger larvæ.

From the present data it appears that oaks of all species are the greatest menace to improvement and development of New England forests as far as the gipsy moth is concerned. If these were cut the

injury by this insect would be greatly reduced, and the same holds true with the brown-tail moth. In certain sections the oaks predominate, but the region is suitable for growing white pine, which is far more valuable, and it is becoming apparent that the oaks will be eliminated, either gradually as a result of moth attack and other insect injury or by the efforts of man to bring about a better forest condition which will at the same time serve to hold these destructive pests in check.

Woodland owners outside the moth infested area should interest themselves in the proper care of their woodlots and should eliminate the oak growth as rapidly as possible so that the trees in their forests will not furnish suitable food for the species when it arrives. In the infested woodlot the problem is more pressing and difficult and needs immediate action if great injury is to be prevented.

PRESIDENT W. D. HUNTER: The next paper will be presented by Mr. Glenn W. Herrick.

MR. GLENN W. HERRICK: With the consent of the Association I wish to read at this time a paper on the control of two fruit flies, *Rhagoletis pomonella* and *R. fausta*, as a substitute for the one on the printed program.[1]

ABSTRACT OF PAPER ON THE CHERRY FRUIT FLIES

By GLENN W. HERRICK

The results obtained by Mr. Illingworth in controlling the apple maggots encouraged him to try similar control measures against the closely allied cherry fruit flies.

It was soon discovered that, in addition to the old species, *Rhagoletis cingulata*, another little known species, *Rhagoletis fausta* was present and doing much injury to the fruit. This species had been reported as injurious to cherries in British Columbia in 1907.

The flies were first seen in the orchard on June 8, 1912. They were first seen ovipositing in the field on June 24. The first maggots were found June 30. Full grown larvæ emerged from cherries on July 8. By the middle of July most of the larvæ of *R. fausta* were found to be mature.

The length of life of the flies confined in glass cages was one month. The flies were supplied with drops of water daily and fed with crushed cherries.

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[1] The paper on "Some External Parasites of Domestic Fowls," has been submitted by Professor Herrick for publication and appears below.

CONTROL. A portion of the orchard was sprayed on June 10 just after the flies were seen and again on June 24. No heavy rains fell during the intervening two weeks. A sweetened mixture of 2½ lbs. arsenate of lead, 1½ gals. of cheap syrup, and 50 gals. of water formed the spraying solution. It was applied to the lower branches of each tree by hand.

On July 11, two crates of cherries, containing an average of 6,400 cherries to the crate, were picked from the sprayed portion of the orchard. The first crate, picked from the tops of the trees in the outside sprayed row, contained seventeen maggots. In the crate picked from the lower branches there were only two maggots. The crate of cherries picked from the check trees was badly infested with curculio and brown rot and fully one-third of the fruit contained maggots. The check rows showed less and less infestation the nearer they were to the sprayed trees.

Flies captured, on the check rows next to those sprayed, died in a day or so, showing that they had obtained poison by going over on the sprayed trees.

All the evidence appears to show that the flies are easily poisoned and that they travel from tree to tree for a considerable distance from where they emerge.

There is considerable evidence being gathered to show that the ordinary codling moth spray, without the addition of syrup, will control these flies.

PRESIDENT W. D. HUNTER: This paper is now open for discussion.

A MEMBER: I would like to ask if *Rhagoletis cingulata* and *fausta* are in the same orchard.

MR. G. W. HERRICK: Yes; they were found in the same orchard at Trumansburg, N. Y., but this test was tried wholly on *fausta*.

MR. W. C. O'KANE: Were all the trees infested?

MR. G. W. HERRICK: The fruit in that orchard was, and in two other orchards, it was badly infested.

MR. W. C. O'KANE: Did all the trees have fruit the previous year?

MR. G. W. HERRICK: I do not know.

MR. W. C. O'KANE: Do you know whether there was such fruiting and infestation the previous season as to insure an equal amount of flies throughout the orchard?

MR. G. W. HERRICK: The flies were on all the trees.

MR. W. C. O'KANE: The reason I bring this point up, is because in the work with the apple maggot we have found it necessary to have the yield, the disposition of the fruit, and the amount of infestation

the previous year recorded, in order to draw conclusions from our spraying.

MR. G. W. HERRICK: In this case we do not know definitely except that the crop during the previous year was a failure.

A MEMBER: May I ask if this ground was heavy clay?

MR. G. W. HERRICK: It was clay soil mixed with gravel and quite stony.

A MEMBER: It has been my experience that cherries are not infested so much on clay soil.

Mr. G. W. HERRICK: There are a good many cherry trees not far from this orchard, but the latter are rather isolated. The fly does not seem to travel very far. The feeding habits of this species are practically the same as those of the house-fly as given in Dr. Howard's book on this subject. The flies are constantly sucking from the fruit which shows the manner in which they get their food from the fruit and leaves.

SOME EXTERNAL INSECT PARASITES OF DOMESTIC FOWLS

GLENN W. HERRICK

Domestic fowls, especially the hen, constitute one of the most important sources of food supplies in America. It is amazing to find that during 1911 the value of poultry in the United States reached a total of $154,663,220 and the value of the eggs produced in the same year in New York State alone amounted to the astonishing sum of 17,102,000 dollars. It is evident that poultry occupies an important place in the life economies of the American people and any pests injuriously affecting domestic fowls are worthy of careful consideration. The study of the external parasites of domestic fowls has extended over several years with many interruptions and delays. It has been difficult to collect the different species infesting fowls and even yet we have not been able to obtain all the species that I feel surely exist in the United States.

According to the different authorities on Mallophaga there are at least eight species infesting the hen, four or five the goose, three or four the turkey, four the duck, four the pea fowl, three the guinea hen, and seven the pigeon.

In addition to the Mallophaga we find that there are in this country at least eighteen species of mites parasitic on the domestic fowl, two species of fleas, one fowl-bug, one tick, and possibly one fly.

Among these parasites the Mallophaga hold the most interest for the author. Some of the most interesting questions of development,

variation, etc., arise out of a consideration of the geographical and host distribution of these parasites. They are wingless insects of world-wide distribution existing wherever members of the bird tribe are found. They are parasites that live for their whole life on the body of their host. They, of course, migrate from one host to another when the hosts are in actual contact, when in copulation; when brooding over the offspring; or when huddling together on perches. Moreover there is occasionally an opportunity for the parasites of a host to actually migrate to a host of another species. For example, we find a certain species of hen louse on the turkey, especially when the two species of domestic fowls are in the same yard. We have also found two species of hen lice on guinea hens where the latter were allowed to frequent the perches and houses of the hens. Kellogg has found the same species of louse on both a cormorant and a pelican shot on the rocky shores of the Pacific Coast where these two species of birds congregated and evidently came in actual contact. But as Kellogg further points out another explanation must be given for the distribution of those species of Mallophaga that are found on birds of the Old World and on closely related birds of the New World. There are many instances of this kind, yet these birds do not come in contact, nor within thousands of miles of each other. Kellogg offers an exceedingly interesting explanation of this phenomenon in distribution. He says, "that the parasitic species has persisted unchanged from the common ancestor of the two or more now distinct but closely allied bird-species." That is to say, these species of Mallophaga existed on the ancestors of the host birds and have persisted ever since without change although their hosts have become modified into different species. This may be explained by the fact that the Mallophaga are surrounded by an environment, namely, the feathers, skin, and temperature of the host, that do not change although the host itself may change. These are not economic questions perhaps but they are intensely interesting ones.

The more important question from an economic point of view is how these parasites injure poultry. The Mallophaga have biting mouth parts and do not suck the blood of their host. In fact, it is doubtful if any of the Mallophaga parasitic on domestic fowls ever get any blood except in case of a wound or bruise on the host from which the blood may issue. In such instances the parasites may eat the dried scales of blood. Blood has been found in some instances in the stomachs of bird lice, probably obtained in the manner just described. Kellogg notes a species of Mallophaga that lives inside of the pouch of the California Brown pelican and clings to the wall of the pouch by its mandibles. Moreover, he has found a small area

surrounding the parasites raw and bloody. It is a question in this case as to what these particular lice eat for food.

It is generally conceded that Mallophaga live upon bits of feathers and scales of the skin. Theobald speaks of them as constantly biting at the skin and causing serious irritation. Other writers hold that the constant movements of the lice cause irritation to the skin by reason of the sharp claws, with which all the feet of these parasites terminate. The presence of the lice sets up an irritation and pruritus that eventually weaken the host and give a chance for various maladies to get hold of the fowl. This seems to be especially true of chicks, where, if the lice are abundant, growth is greatly checked, diarrhœa seems to follow and a general weakened condition may result.

The losses caused by the poultry lice are difficult to estimate but the total must be large. Chickens, when badly infested, fail to make anything like their normal growth. Theobald gives the results of some experiments showing that chicks suffering from lice, at the end of the year, weighed one pound less than those which had been kept free from these pests, both having had exactly the same diet.

The loss in egg production through the infestation of laying hens must be enormous although there is no way of getting even an approximation. Brood-hens are often so irritated by these parasites that many of the failures in hatching must be attributed to the lice. Undoubtedly the presence of the lice, by weakening the general constitutions of their hosts, predisposes the fowls to such diseases as gapes, cholera, roup, etc., and thus contributes to a formidable indirect loss and injury.

List of Mallophaga on Domestic Fowls

The species marked with a * have been collected and are thus known to occur in this country.

On the Hen (*Gallus domesticus*)

**Menopon pallidum* Nitzsch.
**Menopon biseriatum* Piaget.
**Lipeurus heterographus* Nitzsch.
**Lipeurus variabilis* Nitzsch.
Goniodes dissimilis Nitzsch.
Goniodes eynsfordii Theobald.
**Goniocotes gigas* Taschenberg.
**Goniocotes abdominalis* Piaget.
Probably a synonym of *G. gigas*.
**Goniocotes hologaster* Nitzsch.
Goniocotes burnettii Pack.
Probably a synonym of *L. heterographus*.

On the Turkey (*Meleagris gallopavo*)

**Goniodes stylifer* Nitzsch.
**Lipeurus polytrapezius* Nitzsch.
**Menopon biseriatum* Piaget.
Menopon stramineum Nitzsch.
Probably a synonym of *biseriatum*.

On the Goose (*Anser domesticus*)

Lipeurus anseris Gurlt.
**Lipeurus jejunus* Nitzsch.
**Trinoton conspurcatum* Nitzsch.
**Trinoton lituratum* Nitzsch.
**Docophorus icterodes* Nitzsch.

On the Duck (*Anas domesticus*)

**Lipeurus squalidus* Nitzsch.
**Lipeurus heterographus* Nitzsch.
**Docophorus icterodes* Nitzsch.
**Menopon obscurum* Piaget.
**Trinoton luridum* Nitzsch.

On the Pea Fowl (*Pavo cristatus*)

**Menopon phœstomum* Nitzsch.
**Goniodes falcicornis* Nitzsch.
Goniodes parviceps Piaget.
Goniocotes rectangulatus Piaget.

On the Guinea Fowl (*Numida meleagris*)

Menopon numidiæ Denny.
Lipeurus numidiæ Denny.
Goniodes numidianus Denny.
**Goniocotes abdominalis* Piaget.
**Menopon pallidum* Nitzsch.

On the Pigeon (*Columba domestica*)

**Colpocephalum longicaudum* Nitzsch.
**Goniocotes compar* Nitzsch.
**Lipeurus baculus* Nitzsch.
Goniodes damicornis Nitzsch.
Gonoides minor Piaget.
Menopon latum Piaget.
Menopon longicephalum.
**Menopon biseriatum* Piaget.

In addition to the Mallophagan parasites we should like to record the definite occurrence of the hen flea (*Ceratophyllus gallinæ*) more commonly known as *Pulex avium* in this country. Doctor Taschenberg records it from a great variety of birds including domestic fowls but, so far as the writer is aware, it has been recorded from this country but once and that was by Baker in Canad. Ent., Vol. 27, p. 111, under the name *Pulex avium*. This single specimen was contributed by Prof. Herbert Osborn and was collected at Ames, Iowa, but the host was not given.

In the spring of 1912, specimens of this flea were received from Abington, Mass., with an inquiry concerning them and methods of getting rid of them. The specimens were taken from the inside walls and roof of a poultry house but were not collected directly from the fowls. The correspondent informed me that the fleas had bitten her so severely that the bites troubled her for two or three weeks afterwards. The fleas had not been noticed until a few weeks after the purchase of some chickens from a neighbor who had just returned from California. It is thus barely possible that the fleas had been imported from California although the correspondent did not think the neighbor had brought any fowls from that state.

The specimens were submitted to Baron Rothschild of England who determined them as the hen flea, *Ceratophyllus gallinæ*.

PRESIDENT W. D. HUNTER: If there is no further business, adjournment will be in order.

Adjournment.

Afternoon session, Thursday, January 2, 1.30 p. m.

PRESIDENT W. D. HUNTER: The first paper on the program will be presented by Mr. H. J. Quayle on, "Some Natural Enemies of Red Spiders."

SOME NATURAL ENEMIES OF SPIDERS AND MITES

By H. J. QUAYLE

Red spiders and mites, exposed as they usually are throughout their lives on the surface of the leaves or fruit, and not being very active, are subject to the attacks of a considerable number of enemies. Those that I will consider in this paper were observed to feed upon the spiders and mites of citrus trees in the citrus belt of southern California. The thing that seemed most striking in making these observations was the unusual variety of enemies, insects belonging to groups that we know best as not being predaceous. Thrips are certainly better known as plant enemies rather than as predaceous insects. Likewise members of the family Itonididæ (Cecidomyidæ) are better known on account of their gall-making habits and attacks on living plants, rather than as parasites. Staphylinid beetles are most familiar as feeders on decaying vegetable and animal matter, while a much smaller number are known to be predaceous. All members of the family Coniopterygidæ are predatory, but their habits are so little known that they are no less interesting than the others. In addition to these there are the usual Coccinelids, Hemerobiids, Chrysopids, a predaceous bug (*Thriphleps insidiosus*), mites and also a secondary Hymenopterous parasite, a chalcid.

The enemies of spiders as thus far investigated in a little corner of the extreme southwestern part of the United States, and only a beginning has been made, include, aside from several species of Acarina, representatives of six insect orders, the Neuroptera, Thysanoptera, Hemiptera, Coleoptera, Diptera and Hymenoptera. I will consider a few of these that are least known.

Conventzia hageni Bks. This Coniopterygid is one of the commonest enemies of spiders in the southern California citrus section. It feeds on the spiders both in the larval and adult stages.

The eggs are of a pinkish yellow color, oval in shape and are deposited singly on the under surface of the leaves. From six to eight days are required for them to hatch. The larva completes its development in from 18 to 22 days during which time, according to our observations, it molts three times. All stages of the spider are attacked, including eggs, young and adult. In attacking the eggs the mandibles

are thrust through the egg membrane and all of the contents consumed, usually from a single puncture. Ten or fifteen seconds is sufficient time for an egg to be devoured. The contents of the spiders themselves are similarly absorbed except that it requires a longer time, usually from 4 to 7 minutes. One larva devoured 96 spiders in 16 days, another a total of 226 spiders for its development from hatching to pupation, or an average of 15 per day; another 136 spiders in 11 days or 12 per day, and another 253 spiders for its entire larval period.

When mature the larva selects a place on the under side of the leaf, usually along the mid rib, for pupation. The cocoon consists of a double layer of silk, an inner compact layer more or less oval in shape and an outer flat, loosely woven web. Thirteen days are spent as a pupa, when the familiar grayish white "dusky wing," which is about 8 mm. long, emerges.

Oligota oviformis. This species of rove beetle (Staphylinidæ) occurs on citrus trees throughout the southern California section. The egg is of a light orange color and is laid singly on the under surface of the leaf. Hatching occurs in 7 to 9 days, and there appears a slender larva which when full grown is 2 or 3 mm. long. With its sharp pointed mandibles the larva punctures the spider about the center of the body, and by a pump-like action the body contents are sucked out. They, in the case of the common citrus spider, are of a red color and may be distinctly observed passing out of the body of the spider and into the alimentary canal of the more or less transparent larva of Oligota. As most of the body juices of the spider are absorbed they are spewed back again and the spider, which has been made transparent by the removal of the contents, resumes its normal red color and rigidity. This pumping back and forth is repeated two or three times before the mouth parts finally release the victim.

Records on the feeding of the larva of this beetle show that it will consume about twenty spiders each day. This too includes a majority of the more fully mature spiders, since they were transferred daily and consequently the eggs and smaller spiders would be left. Twelve to fifteen days represent the longest period we have been able to get the larva to live, and in spite of repeated efforts, it appears to die just before pupation. Counting the time that has actually been observed the larva of this insect will consume upwards of two hundred or three hundred spiders during its course of development.

The adult beetle does not eat so many spiders each day as the larva, but the longer life of the adult brings the total number consumed about equal. The adults eat on an average ten spiders a day and the maximum adult life determined was 32 days, making a total of over 300 spiders.

Scolothrips sexmaculatus Pergande. Our data on carnivorous thrips are fragamentry except for the species named which has been observed to feed on spiders and mites. This species has been repeatedly observed to feed on the citrus red spider and occurs most abundantly during the winter and early spring. Generally the eggs and younger spiders are eaten, but occasionally fully mature spiders are attacked. The time required to consume the contents of eggs and spiders varied from three to seven or eight minutes. Most of the contents of the egg were taken from a single puncture, then two or three additional punctures would be made on different sides and lower down, to get what little of the contents remained. In the case of the spiders themselves, after taking most of the body contents, the spider would be rolled around and punctured from different sides, the revolving being done by the fore legs of the thrips. The spiders were attacked mostly before the first or second molt and usually at a time when the spider was in a quiescent stage just preliminary to the molting process. All stages of the thrips, barring the pupa, have been noted to feed on the spiders.

Stethorus picipes Csy. This is the commonest species of the Coccinellidæ that was found to feed on the red spider, in fact, the only one of any consequence.

Feeding records on the larva of this beetle showed that in the case of one that lived 20 days it consumed a total of 189 spiders or an average of 6 or 7 per day. Another devoured a total of 110 spiders in 13 days of 8+ per day.

Arthrocnodax occidentalis Felt. This is a species of Itonididæ, the larva of which has been found to feed on the red spider. It has been observed to feed on *Tetranychus mytilaspidis, T. bimaculatus* and *T. sexmaculatus*, being most abundant on the last species, probably because they live in definite colonies and food is obtained with less moving about. Where the number of these Dipterous larvæ is large their effect on checking the spider is considerable. One on which records were kept consumed 165 spiders during a period of 15 days, or 11 per day, and another had 380 spiders to its credit in a period of 17 days or 12 per day. This species was sent to Doctor Felt for identification, who stated that it was a new species and it has since been described in a recent number of the JOURNAL of this Association.

Of the other better known enemies of spiders I will mention briefly but one, one of the Brown lace wings, *Hemerobius californicus* which is very voracious and eats a large number of spiders during its development. Records show that one of these larvæ ate 532 spiders in 17 days, 31 per day and another a total of 897 spiders in 20 days or an average of 44 per day when it died, from overeating or otherwise, though this one was no doubt mature and ready for pupation.

The effect of all these enemies in checking the spiders is difficult to determine. No doubt they aid considerably for each individual has a good many spiders to its credit, but the individuals are not numerous enough and the spiders often appear in large numbers nearly every spring in some sections of the southern California citrus belt.

PRESIDENT W. D HUNTER: We will now listen to a paper by Dr. L. O. Howard, on "Economic Entomology at the Second International Congress of Entomology."

ECONOMIC ENTOMOLOGY AT THE SECOND INTERNATIONAL CONGRESS OF ENTOMOLOGY

By Dr. L. O. HOWARD

(Abstract)

The speaker called attention to the fact that it is only a few years since workers in economic entomology were rather looked down upon by systematists; especially, was this feeling indicated during his visits to the great museums of Europe ten years or more ago. There has, however, been a decided change in this attitude on the part of entomologists of Europe and of other portions of the world; and he spoke of the recent Congress at Oxford as exhibiting in a very recent and concrete shape the radical difference in sentiment which exists today as compared with that of ten years ago. While the program of the section on economic entomology was not especially strong, yet the sessions of that section were attended by larger numbers than those of any other section, and this attendance comprised not only the general public but very many workers in the aspects of pure science. The hall was filled at almost every session.

The speaker said that this increase in interest and this change in the attitude of other workers are natural enough on account of the remarkable discoveries which have been made during the past ten years and the vital interest which attaches to many of the recent discoveries in economic entomology, but he felt sure that the main reason for the change had been the absolutely sound scientific work which has been done by economic workers, and he placed the influence of the Association of Economic Entomologists at the head of the controlling influences. The change has been largely due to the work of this association and to the sound papers which have been published by its members.

PRESIDENT W. D HUNTER: This paper is before the Association for discussion. I believe that the reason for the absence of discussion

on this report is because of its finality and completeness. The next paper will be presented by Mr. Britton.

MOSQUITO CONTROL WORK IN CONNECTICUT IN 1912

By W. E. Britton, *State Entomologist, New Haven, Conn.*

The past year has seen an awakening along the shore region of Connecticut regarding mosquito control. A good beginning has also been made in draining marsh areas. The work herein described has all been done by community effort and the funds expended have been raised wholly by voluntary contributions. Notwithstanding the fact that the whole shore region of Connecticut was examined by my assistants in 1904 and maps and recommendations furnished each town, almost no local action resulted, and it was not until 1911 that the people at Shippan Point, Stamford, raised money and drained about seven miles of coast marsh. In 1912 the idea spread like contagion. Darien and South Norwalk did likewise. Later Fairfield fell into line. In the city of New Haven the subject was agitated the latter part of the winter. An anti-mosquito committee was appointed by the Civic Federation: other organizations were asked to coöperate, and the work was organized under this committee. The entire city was divided into sections and a house to house canvass made. The week ending April 27 was known and advertised as "mosquito week" or "donation week" and was a definite time set aside for raising funds to finance the work of controlling the mosquito nuisance. Not only individuals, but men's clubs in churches, civic and improvement organizations, and business men's associations all worked together toward the end in view.

Many lectures and informal talks illustrated by lantern slides, charts and specimens were given by the State Entomologist or his assistant or some member of the committee. Notwithstanding the effort made we were somewhat disappointed that the total amount raised did not exceed $5,000. The amount needed was $25,000. This money was all expended for draining and oiling around New Haven, beginning with the most important breeding places. The superintendent of parks oiled the principal breeding places in the public parks but otherwise no municipal funds were available for the object of the campaign.

The largest area drained was at Morris Cove and South End east of the harbor. This had been a notorious breeding place for years. Certain small areas were also drained in the West River marsh. The results were satisfactory as far as the work was carried, but much more draining needs to be done.

As far as we can learn little or no salt marsh draining was actually done east of New Haven in 1912, though several communities took up the matter and progressed as far as having their respective territories examined and obtaining estimates. Draining will be done next summer in at least a portion of these communities.

The amount and cost of the draining work is shown in the following table:

MOSQUITO DRAINING IN CONNECTICUT

Location	Approximate Acreage	Cost
Stamford	200	$2,500.00
Darien	300	3,800 00
South Norwalk	600	7,500.00
Fairfield	1,250	8,400.00
New Haven	347	3,567.00
	2,697	$26,067.00

This money was raised entirely by voluntary contributions and the draining contracts were all executed by one firm. The average cost per acre of draining salt marshes is somewhat less than appears from these figures as in a number of cases small inland areas were included and some of the work was done on a footage rate. Nevertheless it falls a little below $10 per acre.

Early in the New Haven campaign the committee planned to oil such breeding places as could not be abolished by draining with the limited time and funds at its disposal. Oiling therefore was practiced on many fresh water pools and also on the salt marsh. The results of the work show that even salt marsh mosquitoes may be controlled by oiling, but I shall not recommend that method. Early in the season it is quite simple and inexpensive but in July, August and September, when breeding is at its height and the grass is tall and flooded at the roots, it is well-nigh impossible to cover the water with oil. Moreover, it should be applied only on the subsidence of the high tides and then not until it appears that the adults may emerge before the pools become dry. Otherwise much money is wasted. From expense accounts it appears that the average expense of oiling for the whole season amounted to nearly $3 per acre or about one third the cost of draining the same area. Drains will last for many years if given slight attention each season to keep them from being clogged by floating debris. The oil kills only the wrigglers in the water at the time and disappears before the next high tide. Kerosene and light fuel oil known as "34° distillate" were used. The latter though somewhat cheaper in lots

of several barrels, is more injurious to vegetation and to the various forms of animal life in the water—some of which destroy wrigglers. Kerosene, on the other hand, does not need to be ordered in advance, and may be obtained at every corner grocery. At first the oil was applied in small compressed air "Auto-Spray" outfits, but later in the season as the breeding became more extensive and more intensive, much more oil was used and larger pumps were needed. The "Double Forester" designed for fighting forest fires and made by W. & B. Douglas, Middletown, Conn., is excellent for this purpose. The Hardie Wheel outfit and several barrel spray pumps were given a trial, but these were difficult to transport across the marsh.

As a result of this crusade it was unusual in late summer to find *Culex sollicitans* around the outskirts of New Haven, where in 1911, this species composed about 90 per cent of the mosquitoes observed in the writer's own garden and on the grounds of the Experiment Station.

There is much more work to be done around New Haven and all along the Connecticut coast. Connecticut has a salt marsh area of over 22,000 acres. The elimination of the salt marsh mosquitoes, besides benefiting the public health, would mean thousands of dollars gain to the shore resorts, summer hotels and transportation companies. All property values would rise. The marsh itself through drainage would yield a profitable crop.

It is too large a problem for communities to solve separately. The movement should be state-wide. State authority to drain land will be asked of the next legislature and a state appropriation will be sought because the work will benefit the whole state. To this end the various organizations have united in preparing a bill to be introduced into the next legislature, and will support it at the hearings before the legislative committees.

PRESIDENT W. D. HUNTER: This paper is now before the Association for discussion.

MR. T. J. HEADLEE: I have been very much interested in this paper, and in view of the fact that many of the entomologists are unfamiliar with the extent of the work accomplished against the mosquitoes in the State of New Jersey by the late Dr. John B. Smith, I am tempted to give a brief account of some of the results he achieved. In 1901 Dr. Smith systematically started the work in New Jersey, and in 1904 published a report setting forth the results of his investigations. In this report it was shown that in addition to the local breeding species of mosquitoes found more or less generally all over the country, the New Jersey problem was complicated by the breeding

of untold millions of salt marsh forms, which while they bred exclusively on the salt marsh migrated from 30 to 40 miles inland. No matter how earnestly a municipality in the zone covered by these salt marsh species might endeavor to rid itself of mosquitoes, the good results of the prevention of the local breeding were always likely to be obscured by the influx of salt marsh broods. In the year 1906, the legislature passed a bill carrying an appropriation of $350,000 to be expended in the control of the salt marsh mosquitoes. Operating under this law about one fourth of the 200,000 acres of salt marsh have been drained, and the prevention of salt marsh mosquito breeding made in these areas merely a matter of keeping the drainage systems in operation. This drainage has covered the salt marsh along the coast from Secaucus on the north to a point some distance below Barnegat. Approximately $115,000 have been expended in this drainage. It is probable that already several millions have been added to the rateables of the state through this work of drainage, and the completion of the work cannot fail to increase the rateables of the state by less than twenty-one or twenty-two million dollars. This drainage, the investigation which preceded it, the convincing of the people of New Jersey that the drainage would control the salt marsh species of mosquitoes, and that it should be taken up without further delay, was the work of Dr. John B. Smith. When the salt marsh is all drained and the salt marsh mosquitoes eliminated from consideration, there still remains the problem of controlling the local breeding species. To meet this condition, the New Jersey legislature of 1912 passed a County Mosquito Extermination Commission law under which every county can have its local mosquito extermination commission and provide its own funds for the cleaning up of its own mosquitoes. Two counties in New Jersey have taken advantage of this law already and have produced results of such a nature as to encourage the other counties of the state.

DR. L. O HOWARD: I should like to ask Mr. Quayle what is now being done in California.

MR. H. J. QUAYLE: The work in 1904–5 was successful, but the following year the earthquake destroyed parts of the levee and it has gradually become weaker each year since. The people of that section are now, however, beginning the construction of a permanent levee and are attempting to make the area within permanently safe by ditching. The construction was just begun when I left California.

PRESIDENT W. D. HUNTER: This is the only paper on mosquitoes. Is there any further discussion?

MR. C. F. HODGE: I have nothing new to report on the mosquito work except that we have done away with screen windows and

doors, and have not even put the screens on our out-door sleeping porch the past summer. This is the result of quite a long anti-mosquito campaign in Worcester, Mass. It was begun by my class in biology making a mosquito survey of the city in 1902, then the schools, some of them, took up the matter; the pupils attending to stagnant water about their own homes and also draining and oiling pools in different sections of the city. This all went to form the basis of more thorough and permanent action. The Blackstone River was walled and all swampy places along its course filled. Beaver Brook has been laid in a cement channel and the low places are now being filled in this district, so that now a little oil on the few remaining pools gives us practical freedom from mosquitoes, which had formerly made certain parts of the city almost uninhabitable. Malaria, which had been gaining ground rapidly is now almost, if not quite, banished from Worcester. The last thing that remains is to find some effective treatment for catch basins in sewers. This is the "last ditch" for *C. pipiens* and, at times, is a very serious problem. There ought to be some kind of float invented for the outflow pipe which will make the use of surface oiling effective in the catch-basins of cities.

PRESIDENT W. D. HUNTER: If there is no further discussion, we will have Prof. Cooley read his paper on "Notes on the Habits of the Spotted Fever Tick."

NOTES ON LITTLE KNOWN HABITS OF THE ROCKY MOUNTAIN SPOTTED FEVER TICK (DERMACENTOR VENUSTUS BANKS)

By R. A. COOLEY, *Montana Agricultural College*

It is well known that most ticks in all of the active stages of their development ascend grass, small bushes or other supports in order that they may catch hold of passing animals. This adaptation is a very necessary one in view of the fact that their only chance of securing a host is by waiting for one to pass within reach.

In connection with the investigations of the Rocky Mountain Spotted fever tick (*Dermacentor venustus* Banks) in the Bitter Root Valley, Montana, in coöperation with the Bureau of Entomology, interesting observations have been made on the waiting habit of this species. In numerous instances in nature and in out-of-door conditions, which very closely resemble nature, adults of this tick have been found in a definite "waiting attitude" which we regard as habitual. A dead, bare, upright twig, or grass stem, is usually selected

and, with the capitulum directed downward, the support is firmly grasped with the third pair of legs, these legs serving as the only means of attachment while the first, second and fourth pairs are extended and waved in reaching for animals which approach.

In arranging to have made a drawing of ticks in this attitude, eleven individuals, including both sexes, were placed in a very large lamp globe pressed into a box of soil and covered by a piece of gauze. Small, bare sticks and grass stems were erected in the soil. Several days passed during which the ticks crawled about the cage without apparent purpose and then, one by one, a part of both sexes came to rest and assumed the "waiting attitude."

It was soon observed that when left undisturbed the legs were all slowly brought down in contact with the support, but when the hand was passed between them and the nearest window, five feet away, all the legs, excepting the third pair, were instantly extended and slightly waved as though reaching for a host. The cage was left in the same place, out of the direct sunshine, for about nine weeks and during that period the test was repeated very many times by several persons. It was further noticed that the ticks showed a distinct preference for the side of the twigs toward the window, which brought the dorsal surface and the eyes toward the strongest light. It seems clear, therefore, that stimulation is received through the eyes and probable that this tick becomes aware of the approach of animals by the occurrence of shadows or by cutting off light.

In one instance, while the cage was temporarily in the sunshine, we were able to "lead" a tick across the smooth ground in the bottom of the cage by suddenly casting the shadow of a pencil upon it through the glass wall. The tick immediately changed the direction of its movement and walked rapidly under the shadow toward the pencil, avoiding the sunlight at the sides. It is well understood, and we have demonstrated, that ticks avoid direct sunlight and it is possible that this tick was seeking protection from the sun, but it is equally possible that this observation indicates another adaptation for securing a host, for it is clear that in nature a suddenly appearing shadow means the approach of an animal and that by following under the shadow toward the sun the tick will arrive at the feet of the host. We have been told by persons in Montana that after sitting on the ground for a short time they have seen ticks crawling toward them on the ground.

Blowing the breath through the top of the cage always caused the ticks to quickly extend the legs the same as when the light was cut off. Suddenly blowing the hot breath into the cage sometimes caused them to drop quickly to the ground. It seems to be indicated that

the ticks may be informed of the presence of a host by feeling its breath and that they may avoid being taken into the mouth with the food of animals, by dropping when a hot breath is felt. In a few instances this tick has been seen waiting on green grass in our large open-air cages, but this is exceptional and dead stems are distinctly preferred by the adults. If the selection of dead rather than living vegetation as supports is a fixed habit, it doubtless serves as a protection against being destroyed in the mouths of animals.

Repeated attempts were made at stimulation by the heat or odor of the hand applied at the top of the cage about five inches away from the ticks but without success.

PRESIDENT W. D. HUNTER: We are now ready for the discussion on this paper.

MR. E. C. COTTON: I would like to ask Mr. Cooley if he ever has detected any indication of a sense of smell by this tick.

MR. R. A. COOLEY: I have not detected any evidence of the sense of smell in this tick. We had this sense in mind when we tried to stimulate the individuals in the cage by placing the hand close to the top, thinking that the heat or odor might arouse them. The results were negative.

PRESIDENT W. D. HUNTER: Professor Cooley's work reminds us that remarkable progress has been made in the study of the adaptations of ticks. In fact, our knowledge of adaptations in this group is rapidly becoming more complete than among insects proper. Heretofore the contributions that have been made have dealt largely with structural adaptations but Professor Cooley's contribution deals with one of a physiological character. These extreme adaptations are not surprising in view of the inability of the tick to move about and its necessity for waiting until a suitable host appears. The longevity of one stage of the spotted fever tick has been determined to be over six hundred days. Evidently the physiological adaptation to which Professor Cooley has called attention is an effort on the part of the organism to reduce this long period of waiting by extreme activity in the presence of a possible host.

A MEMBER: Will the cattle tick when it climbs up spears of grass show similar habits?

MR. E. C. COTTON: In the case of the cattle tick we have a different situation for here it is the seed tick stage we find on grass instead of the unengorged adult. The seed ticks occur in large clusters, as many as 2,500 in a bunch instead of singly as with the unengorged adult of the spotted fever tick, therefore it is more difficult to observe indi-

vidual movements, but they do wave the first pair of legs when disturbed. If a host comes within reach they are able to get on.

MR. BRAIN: In connection with this point I might mention that in the case of *Argas persicus* Oken, the sense of smell seems to be depended upon almost entirely in finding a host. Temperature probably plays a slight part too, but I found by experiment that if the first pair of legs are amputated the ticks live quite well for a time, but apparently die later of starvation. A number of such ticks were placed, together with normal specimens, in a box containing a chicken. Next morning it was found that 27 out of 30 of the normal ticks had fed while only 1 out of 30 of the specimens without the front pair of legs was engorged.

PRESIDENT W. D. HUNTER: In that case are the legs not used for grasping?

MR. BRAIN: I think not. The ticks use them most for touch. The front pair are not used for grasping.

MR. E. C. COTTON: In regard to Mr. Hunter's question I think that Dr. Nuttall, of the University of Cambridge, has demonstrated very nicely that ticks are dependent upon the Haller's organ for the location of their host. This organ which is olfactory in function, and the only sense organ that has been clearly demonstrated in ticks, is situated on the last tarsal segment of the first pair of legs. With ticks of four different species, which in nature feed only upon blood, he was able, by amputating this segment, thus removing the sense of smell, to induce them to engorge on various liquids some of which caused the death of the tick.

PRESIDENT W. D. HUNTER: If there is no further discussion we will proceed to the next paper by Mr. S. J. Hunter, on "Pellagra and the Sand-fly."

PELLAGRA AND THE SAND-FLY, II

By S. J. HUNTER, *University of Kansas, Lawrence, Kans.*

At the Washington meeting last year an account of this work up to that time was given, in which 1,282 live sand-flies were used in an endeavor to produce experimentally Pellagra in guinea pigs and monkeys. The work was resumed at the opening of spring this season and covered three lines of investigations.[1]

[1] As last year this work has been carried on with the assistance of Mr. W. T. Emery, one of my graduate students and the pathologic side has been conducted in conjunction with Dean Crumbine and the School of Medicine.

1. The survey on the distribution of sand-flies in Kansas.

2. A detailed investigation into their life habits and conditions under which they exist.

3. Continuation of the inoculation experiments.

Since these investigations when completed will be published in full it is not the purpose of this paper to occupy your time now with details, but rather to give in briefest possible form a summary of the work thus far, under the above heads.

I—DISTRIBUTON: The only species thus far found to be generally distributed over the state is *Simulium vittatum*. The survey thus far seems to show that the immature forms of this species may be found where ever there is trickling water, throughout the summer months. I use the word *trickling* in order to include waters which flow from running springs, in little rivulets through the grass. Here attached to the blades of such grass *Simulium* larvæ sometimes abound.

II—LIFE HISTORY: This species is not confined to clear or pure water. A short distance below where the septic tank of a city of the second class empties into the Neosho, larvæ and pupæ were abundant this season.

In an examination of the riffles for a considerable distance along the bed of a small creek, the only place these larvæ were found was in the riffles running through a hog lot. There the hogs were wallowing and polluting the waters in and above the riffles.

They are not confined to the rural districts but are found in Turkey Creek which runs through a populous part of Kansas City. Last season they were more abundant here than elsewhere.

The females prefer to oviposit in the evening and place their eggs on wet leaves in shallow ripples or on rocks in the same position. They usually place the tip of the abdomen in the water where the water comes up on the rocks in a thin film on the down side of the stream. As the fly oviposits she moves along, stringing the eggs, but holding on to the rock above the water while the tip of the wings and abdomen are vibrating in the water. This process occupies in all about ten minutes and about 200 eggs are usually deposited.

When first deposited the eggs are whitish or creamy in color, turning yellowish, then brownish and almost black at the time of hatching.

When first hatched the larvæ are almost invisible with an ordinary 12x lens.

The duration of the egg stage depends somewhat upon the temperature of the surrounding water, though usually lasting about a week.

The length of the larval stage depends upon the temperature of the water and upon its rapidity. It varies from three or four weeks

under good conditions to several months, as this is the overwintering stage.

The duration of the pupal stage varies but is usually two to three weeks.

The length of the adult's life is not definitely known though the flies have been observed to live several days. Those which have fed on human blood exist for a longer period than those which have not. Such have existed eight days before being used. There are two principal broods, one in July and one in October, though some are found emerging throughout the entire season.

As far as our observations go, based on the work of the fly and the anatomy of its mouth-parts these flies do not pierce but rather scrape until the blood oozes through the denuded spot. At certain times they bite the human skin readily. A second fly has been observed to participate in lapping up the superabundance of blood caused by the scraping of the first fly.

III—EXPERIMENTS: Last season the flies were very abundant. This season they were notably rare, due principally to the flooded condition of the creeks in the northern part of the state and to the continued drouth in the southern part of the state.

Turkey Creek in the southern part of the state where our breeding experiments were so successful last year was entirely dry this season and the rocks covered with quantities of dried pupæ and larvæ.

It was not possible, therefore, to conduct as many inoculation experiments as last year, due to the absence of flies and likewise to the absence of incipient cases of Pellagra.

Last year we had an abundance of flies and nine cases of Pellagra. This year we had few flies and only two new cases of Pellagra.

Six monkeys were imported direct from India for this work. The almost total absence of flies in July as well as the want of a Pellagrin in the proper stage prevented any successful inoculations then. In the fall brood two inoculations have been made without waiting for the flies to bite the monkey after having bitten the Pellagrin but introducing them by maceration attended by the proper aseptic precautions.

The last inoculation, thus far, was made on a second monkey on the dates of December 16, 17 and 20, using flies that had emerged on the 12th and had bitten the Pellagrin on the 14th.

Obviously sufficient time has not elapsed for the results of these experiments to become apparent.

Summing up the work of the past two years, for and against the Sambon theory:—

1. The number of sand-flies has been directly proportional to the number of cases of Pellagra.

2. The first appearance of the cases of Pellagra is coincident with the principal broods.

3. Just succeeding the time of the principal broods the flies appear to bite more vigorously.

4. Sand-flies which have fed on human blood live several days longer than those which have not been so nourished, thus favoring an incubation period for a parasite if such there be.

5. Pellagra, thus far in Kansas, has appeared almost entirely in one restricted locality. Of the nine cases recorded last year five were traced back to one town. In this region flies are widely distributed and unusually abundant.

Upon the other hand,

1. Pellagra has never been produced in any other animal experimentally either through inoculation or through transference by means of sand-flies.

As far as our history of this subject goes the appearance of Pellagra in Kansas is a recent occurrence. Nearly all of the cases are those of natives that have never been out of the state.

From this it would seem that the etiology of Pellagra exists in Kansas.

The situation here is not complicated through long standing conditions. It is the purpose, therefore, to continue this phase of the work and with it the correlation of the clinical and pathological phases by the medical school of the University of Kansas.

MR. S. J. HUNTER: To illustrate one point: we took this problem up two years ago and reported Douglas County, the county in which the University of Kansas is located, as being absolutely free from Sand-fly, and last June I stepped across a stream in the grass which ran about five gallons an hour as an overflow of one of the campus drinking fountains, and found the larvæ there on the blades of the grass in great numbers. That is, it requires an unusual scrutiny of conditions in any given locality before a conclusion can be safely drawn regarding the presence or absence of the Sand-fly.

PRESIDENT W. D. HUNTER: The reader spoke advisedly when he referred to the Sambon theory. It is surprising that Doctor Sambon has performed no experiments whatever. He has merely drawn conclusions. The work of Mr. Hunter is much more suggestive as regards the demonstration of the possible transmission of pellagra by Sand-flies than anything that has been done and allows the suggestion that if the Sambon theory is ever proven it is likely that some other investigator will accomplish it. The investigation in South Carolina, which

the Bureau of Entomology has been conducting in coöperation with the Thompson-McFadden Commission of the New York Postgraduate School of Medicine, has failed to reveal any circumstance that tends to connect Simulium with pellagra transmission. In this work, by means of special facilities provided, an extremely exhaustive investigation of pellagra in a rather restricted locality was conducted. A house to house canvass was carried out and complete accounts of the histories and surroundings of cases were compiled Simulium is present, but not in sufficient numbers and not in the exact places where it would appear possible that they were connected with the disease.

MR. S. J. HUNTER: We talked that over quite fully, Dr. Siler of the Army Medical Corps and I, and both of us spoke of the fact that it was remarkable that a purely geographical theory should receive so much attention. Dr. Siler explains it on the grounds that Sambon seems to be a good prognosticator. For example, Dr. Siler spoke of visiting peasant huts with Dr. Sambon, where cattle and people lived under the same roof. Here the stable fly was feeding on both the cattle and peasant. Dr. Sambon remarked to Dr. Siler that there would in all probability be an outbreak of Anthrax here soon. And such an outbreak did shortly occur. One of Sambon's deductions, if frequently corroborated, must certainly be considered as important in its relation to his theory. That is, parents and children may all be pellagrins, living in a Sand-fly zone but when the family moves out of the Sand-fly zone subsequent offspring are free from Pellagra.

MR. W. A. RILEY: I should like to inquire whether there are any further data relative to the susceptibility to pellagra of the monkeys which are being experimented upon. It is well-known that the typical insect-borne diseases may be transmitted from animal to animal by transfusion of blood as well as by the insect host. This is true of malaria, yellow fever, Texas fever of cattle, and various trypanosome and other diseases. As I recall the report of last year, there was no evidence that the monkeys were affected by transfusion of blood from a pellagrin.

S. J. HUNTER: That is a question we discussed last year. The monkey has been tried in every shape and form. Transfusions of living blood, inoculation of various organs and tissues taken from recently deceased subjects gave negative results. In this particular, Infantile Paralysis differs in that it was produced experimentally before being carried through the agency of the stable fly.

MR. W. A. RILEY: In view of the known difficulty in carrying on experiments regarding the insect transmission of disease, would it not be important to first determine the suceptibility of the animals experimented upon. If the animals are not susceptible of course

experiments with them to determine whether Simulium transmits pellagra would be futile.

MR. S. J. HUNTER: I may say that the results of the experiments in the laboratory failed to prove that the monkey was susceptible.

PRESIDENT W. D. HUNTER: Is there any further discussion? If not, the next paper is by Mr. C. T. Brues on "The Transmission of Infantile Paralysis by *Stomoxys calcitrans*."

THE RELATION OF THE STABLE FLY (STOMOXYS CALCITRANS) TO THE TRANSMISSION OF INFANTILE PARALYSIS[1]

A Résumé of Observations by Brues and Sheppard and of Experiments by Rosenau and Brues

By CHARLES T. BRUES

Infantile paralysis, more accurately designated anterior poliomyelitis or acute epidemic poliomyelitis, is a disease which has aroused much interest in the United States for a number of years on account of its serious nature and much increased prevalence. Complete ignorance as to the way in which it spreads and develops in epidemic form has also served to augment the dread of this disease. It affords me great satisfaction, therefore, to be able to present today a résumé of some observations and experiments bearing on the probable method of transmission of infantile paralysis.

These entomological investigations were conducted under the auspices of the Massachusetts State Board of Health and have extended over a period of two years. The State Board had previously conducted extensive investigations along various lines under the guidance of an advisory committee consisting of Drs. R. W. Lovett, M. W. Richardson, M. J. Rosenau, Theobald Smith, J. H. Wright and J. L. Morse, and Doctor Richardson later gave much of his time to further the success of the entomological work. During the summer of 1911 an extended series of entomological field observations was made by the writer in association with Dr. P. A. E. Sheppard who was studying the epidemiology of the disease for the State Board of Health. The more important facts then ascertained have already been published in the JOURNAL OF ECONOMIC ENTOMOLOGY[2]

[1] Contributions from the Entomological Laboratory of the Bussey Institution, Harvard University, No. 62.

[2] Brues, C. T. and Sheppard, P. A. E. The Possible Etiological Relation of Certain Biting Insects to the Spread of Infantile Paralysis. Journ. Econ. Entom. Vol. 5, No. 4, pp. 305–324 (1912), previously briefly abstracted in the Monthly Bulletin of the Mass. State Board of Health for December 1911, pp. 337–340.

together with the hypothesis based on these observations, that *Stomoxys calcitrans* might be responsible for the spread of poliomyelitis, aided possibly by other blood-sucking flies. During the summer of 1912 an attempt was made by Prof. M. J. Rosenau of the Harvard Medical School and the writer to transmit the disease experimentally through the agency of *Stomoxys*, using monkeys for this purpose, as these animals are susceptible to poliomyelitis. The successful outcome of this work was announced in September, 1912,[1] and was soon afterwards confirmed by Doctors Anderson and Frost of the Public Health and Marine-Hospital Service, who repeated the same experiments with similarly positive results.[2]

Infantile paralysis was first recognized as a distinct disease in 1840 by Heine, a German surgeon who found that the spinal cord was the site of attack. Many years later, Strümpel in 1848, suggested that the lesions in the cord were caused by an infectious agent, and in 1890 Medin published the first good clinical account of poliomyelitis. Within the last ten years, Wickman in Sweden and various others, both in Europe and America, have investigated the disease with great care, so that its clinical, epidemiological and pathological aspects are well known.

The living organism which causes the lesions in the spinal cord is not known, but it has been demonstrated to be an ultravisible virus which passes through a Berkefeld filter only with difficulty, suggesting that it is just beyond the range of visibility.[3] Its pathogenic activities are mainly restricted to the anterior portions of the spinal cord where the motor nerves take their origin, and the resulting degeneration of these motor nerves produces a more or less complete paralysis of the corresponding muscular elements. The arms and legs are most frequently affected, although paralysis of many other muscles is common in varied combinations, sometimes bilateral or unilateral, but often irregular in distribution. In fatal cases, death usually results from a paralysis of the respiratory muscles and consequent asphyxiation. The actual mortality is rather low, averaging from 12 to 17 per cent, when only typical, paralytic cases are considered. In

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[1] Rosenau, M. J. and Brues, C. T. Some Experimental Observations upon Monkeys Concerning the Transmission of Poliomyelitis through the Agency of *Stomoxys calcitrans*. Bull. Mass. State Board Health, Sept. 1912, pp. 314–317.

[2] Anderson, J. F. and Frost, W. H. Transmission of Poliomyelitis by Means of the Stable fly, *Stomoxys calcitrans*. Public Health Reports, Vol. 27, No. 43, pp. 1733–1735. (October 1912.)

[3] Since this article was written, Flexner and Noguchi (Journ. Amer. Med. Assoc., February 1, 1913) have obtained in cultures, extremely minute bodies of variable size and appearance which they believe may be the causative organism. This, however, is still somewhat in doubt.

addition there are undoubtedly many mild, atypical or abortive cases which are difficult of diagnosis. Of the remaining 83–88 per cent, about 25 per cent, recover entirely, some very quickly and a few others only after a number of months, while about 60 per cent remain permanently crippled in varying degrees. Children under six years of age are most commonly affected, approximately two thirds of the cases falling into this period. Adult cases are far less frequent, but here the mortality is correspondingly higher, and there is less likelihood of regained muscular control in non-fatal cases. Poliomyelitis is difficult to recognize in its earlier stages, for the preparalytic functional disturbances are not ordinarily at all commensurate with the grave nature of the disease. Prognosis is equally difficult, owing to the subsequent very erratic course of the infection.

On account of its greater prevalence in the Scandinavian peninsula and in Germany, it has been suggested that poliomyelitis was introduced into America from one of these European countries. However this may be, during the last seven or eight years our own country has suffered more than any other, although the increased prevalence of the disease here has been paralleled in parts of Europe, and outbreaks have occurred in the West Indies, in Australia, and in other parts of the world. For several years prior to our entomological work, there had been a growing suspicion among those familiar with the disease, that poliomyelitis like several other epidemic diseases, might be insect-borne. Since no data had been collected with this possibility directly in mind, it was necessary to determine a number of points by means of the direct observation of a large series of cases, before it was possible definitely to suspect any particular insect as a probable carrier. However, from previously made studies on the epidemiology of the disease, it appeared that many facts suggested some relation between insects and poliomyelitis.

Cases usually appear sporadically and very frequently in such a way as to render it very difficult to explain their origin on the basis of infection by personal contact. They also show a seasonal distribution very different from what might be expected of a contact infection. In winter the disease almost disappears, at the time when children are in closest association both in schools and elsewhere, but rapidly increases in prevalence during the summer, in late June and July, to a maximum in August, then rapidly decreases in September and October to the very slight winter incidence. Geographically, again, poliomyelitis does not follow the lines of densest population, but is on the contrary, quite generally typical of rural, or at least semi-rural districts. Thus in Massachusetts, in 1909, of the cities and towns where the disease occurred, the twenty-five most affected

showed an incidence ranging from 5.26 to 1.12 per thousand (averaging 1.94), the average population of these places being 3,294; the twenty-five least affected showed an incidence of from .15 to .012 per thousand, (averaging .098) and had an average population of 32,217. Complete data concerning many other regions are difficult to collocate, but the greater rural incidence seems to be an established fact. The significance of this distribution becomes very great when we consider the fact that both domestic animals and the majority of insect species are most abundant over the same areas where poliomyelitis appears in its most extensive outbreaks.

With these, and other considerations of minor importance in mind, it became possible to draw some tentative conclusions which might be strengthened or disposed of by the actual examination of the environment of a series of cases.

As a matter of fact, members of nearly all groups of insects which by their life-history seem suited to play a part in the dissemination of disease, have been implicated either as specific or contaminative carriers of disease in man or the higher mammals. The seasonal distribution of poliomyelitis makes it evident at once that insects like fleas, which are known to carry plague; lice which transmit typhus fever; or bedbugs, which are suspected of distributing kala-azar fever, could hardly account for the high summer incidence and practical winter disappearance of poliomyelitis. They vary somewhat in abundance with the progression of the seasons, but are nevertheless quite prevalent all through the winter. Mosquito-borne diseases of course, show a very decided æstival periodicity, but at least in the case of yellow fever, malarial fever and dengue, spread very rapidly in epidemic form, involving a much greater percentage of the population of a community. This is quite to be expected, on account of the general abundance of mosquitoes and their great persistence in search for human blood. For this reason they enjoy great opportunities of infection in the presence of a case of one of these diseases, and exhibit a corresponding activity in distributing the organisms later among other persons. Thus, while poliomyelitis appears in truly epidemic form, it has never developed into extensive outbreaks, comparable with those of mosquito-borne diseases. There appeared, however, no very decided reason why some relatively rare mosquito might not be concerned, except that the summer abundance of poliomyelitis does not show any regular relation to rainfall or to general mosquito prevalence. Ticks are known to act as vectors for a number of diseases, but on account of their method of attachment to the skin of the host for considerable periods, are very noticeable, and in none of the cases visited could we demonstrate the occurrence of a tick bite, either by

examination or by questions relative to the history of the case before the onset of symptoms. Certain Reduviid bugs are know to carry a trypanosome disease of man known as barbiero fever in the American tropics, but as all of our native species of this family appear to inflict very painful bites, the failure to obtain histories of such bites, seemed to eliminate these bugs from any connection with poliomyelitis.

There remain various Diptera with blood-sucking habits, and some of these seemed to offer the most promising field for investigation. Many, however, for one reason or another fail to meet all necessary requirements. Gadflies, of the genus *Tabanus* have been sometimes especially noticeable in localities where epidemics of poliomyelitis have occurred, notably in maritime towns, but they are not so abundant in the inland rural communities. Their place is there taken by the related *Chrysops*, but these do not occur in the later part of summer, when the disease shows its greatest incidence. On account of their great thirst for blood, the small black flies of the genus *Simulium* have been suspected as carriers of a human disease known as pellagra. They are most abundant in the spring, at least in our region, and may thus be ruled out as possible vectors for the virus of poliomyelitis. The horn-fly, *Hæmatobia*, appears in abundance occasionally upon animals on farms, but was seen in the vicinity of only a small proportion of the cases visited.

In addition to the insects already mentioned, which might be expected to act as specific carriers, there are others, like the common house fly which may act as contaminative carriers for certain bacterial diseases. Such a method of spread is always supplementary to infection by contact, ingestion, etc., and as such channels of infection had not been demonstrated otherwise, it seemed very unlikely that the house fly should bear any relation to the transmission of poliomyelitis.

After thus considering the various possibilities, it appeared probable that the common blood-sucking stable fly, *Stomoxys calcitrans*, might be implicated. In fact, this seemed to be the only insect which could not be disregarded for one or more of the reasons set forth above. Briefly, the reasons for suspecting a relation between *Stomoxys* and poliomyelitis were the following:

1. The blood-sucking habits of the adult fly suit it for the transfer of virus present in the blood.

2. The seasonal abundance of the fly is very closely correlated with the incidence of the disease, rising rapidly during the summer, and reaching a maximum in July and August; then slowly declining in September and October.

3. The geographical distribution of the fly is, so far as can be ascertained, wider, or at least co-extensive with that of poliomyelitis.

4. Stomoxys is distinctly more abundant under rural conditions, than in cities and thickly populated areas.

5. While the disease spreads over districts quickly and in a rather erratic way, it often appears to follow along lines of travel, and it is known that Stomoxys flies will often follow horses for long distances along highways.

6. In a surprisingly large number of cases, it appeared probable that the children affected had been in the habit of frequenting places where Stomoxys is particularly abundant, *i.e.*, about stables, barnyards, etc.

During the summer of 1911, 88 cases of poliomyelitis were visited and studied both with regard to the individual histories of the patients and to the insect fauna of their environment. Stomoxys was found in every case, and often in exceptional abundance, while nothing appeared which would cast doubt upon a possible association of this insect with the disease.

The suspicion attaching to Stomoxys seemed to be strong enough to warrant direct experimentation, and during the past summer Prof. M. J. Rosenau of the Harvard Medical School and the present writer attempted to ascertain by experiments with monkeys whether the virus of poliomyelitis could actually be transferred by Stomoxys under controlled laboratory conditions. For this purpose a large cage was constructed of light wood, with a flat wooden base about four by five feet in size, with sides three feet in height. The sides and a part of the top were covered with ordinary screen wire, a strip one foot wide being left along one side of the top. The inner walls were further lined with surgeon's gauze to afford a resting place for the flies, and the open part of the top provided with a large black cloth which could be lifted to give access to the interior of the cage. Specimens of Stomoxys were collected daily in amounts of from 300 to 500 and admitted to the cage, so that in spite of the high mortality among the flies thus caged, a thousand or more were continually present. A healthy monkey was now infected with poliomyelitis by inoculation in the brain with a lethal dose of active virus of the disease. The virus in this case was obtained by making an emulsion of bits of spinal cord from monkeys which had died of the disease after being similarly infected; it had come originally from a human case of the disease, but had been later passed through a number of monkeys, as can be done without impairing its virulence. This monkey was then exposed to the captive flies daily, by stretching it at full length and rolling it in a piece of chicken wire, then placing it on the floor of the cage. Such treatment was necessary as the agile monkey would otherwise soon have demolished the frail cage. The Stomoxys fed on it freely during

this period, as well as later, after paralysis had set in. This usually appears on the fourth or fifth day, and death ensues several days later. Alternating with the inoculated monkey, healthy monkeys were similarly introduced into the cage at intervals. In this way new monkeys were inoculated to keep a supply of such infected animals and additional healthy ones were exposed to the flies, which fed willingly and in considerable numbers on each occasion. Thus the flies were given every opportunity to obtain infection from the monkeys, since the animals were bitten during practically every stage of the disease from the time of the inoculation of the virus till their death following the appearance of paralysis. By the same arrangement the healthy monkeys were likely to be bitten by flies that had previously fed during the various stages of the disease on the infected monkeys. The flies had meanwhile enjoyed the opportunity of incubating the virus for periods varying from the day or two which usually elapses between consecutive feedings, to the two- or three-week period for which at least some (although a very small percentage) of the flies lived in the cage.

At this point it should be mentioned that no fear was to be entertained that the healthy monkeys might become infected on account of their being introduced into the cage in which the poliomyelitic animals had been placed. Attempts to transfer the disease under conditions of far more intimate nature have been made, but have always given negative results.

In all, twelve apparently healthy monkeys of a small Javan species were exposed to the flies in the manner described for the infected monkeys. Some were placed in the cage only once or twice, and others a number of times after varying intervals. These exposures usually lasted for about half an hour, but were sometimes more protracted. No results were apparent until two or three weeks after the experiment was well under way, and then in rather rapid succession six of the animals developed symptoms of poliomyelitis. In three, the disease appeared in a virulent form, resulting in death, while the other three experienced transient tremblings, diarrhœa, partial paralysis and recovery. It is interesting to note that several of the monkeys had diarrhœa, wherein their affection resembled the human disease more closely than the type developed in monkeys after inoculation with virus in the brain, for gastro-intestinal upsets in children are frequently associated with infantile paralysis.

In support of the clinical appearance of the disease in the fly-bitten monkeys, microscopic examination of the spinal cord revealed the characteristic lesions of poliomyelitis, but we were unable to induce the disease in further monkeys by intracerebral inoculations with

emulsions from the cords of the dead monkeys. This is at present the most accurate method of diagnosing the disease.

Soon after these results were announced, however, Drs. J. F. Anderson and W. H. Frost of the Public Health Service repeated these experiments in the federal hygienic laboratory at Washington. They obtained the disease in healthy monkeys that had been bitten by Stomoxys which had previously fed on intracerebrally inoculated monkeys, and further succeeded in inducing the disease in another monkey by inoculation with emulsion of the spinal cord from one of those which had been infected by the flies.

It thus appears to have been satisfactorily demonstrated that Stomoxys can transmit infantile paralysis from one monkey to another. Whether this is the ordinary method of spread, remains yet to be definitely shown. It has already been stated, however, how well the seasonal occurrence, distribution and other facts connected with Stomoxys agree with the epidemiology of the disease.

Although many facts are well in accord with such a method of spread, the results of some investigators appear at first sight to be at variance with such a view, and these should be given careful consideration. It has been shown by a number of workers that the virus exists in the nasal mucosa. By most extensive observations, moreover, Kling, Pettersson and Wernstedt in Sweden have succeeded in many instances in producing poliomyelitis in monkeys by inoculating into the nervous system material washed from the mucous membranes of persons who had died of the disease, of those suffering from it, and of healthy persons in close contact with patients. This has led them to believe that the infection is ordinarily acquired through the mucous membranes, the virus being derived from this same site in those suffering from the disease. One important link is missing in this chain of evidence, however: it has never been shown that virus derived from the mucosa can produce poliomyelitis by implantation on the mucosa of healthy monkeys. We must, therefore, assume a fundamental difference in susceptibility between man and monkey, if these results are believed to have any significance in relation to the ordinary method of spread of poliomyelitis. Such a difference in susceptibility is improbable in view of the ease with which monkeys may be infected by other methods. A second objection lies in the fact that virus direct from the spinal cord can sometimes produce infection by implantation on the nasal mucosa, but as the virus from the mucosa cannot, so far as we know, and since, outside of the laboratory, virus from the cord never reaches the mucosa of a healthy individual, the bearing of these experiments on the possibility of natural transmission in this way must be regarded as not yet proven.

Flexner, Howard and Clark in this country, and others abroad have worked to some extent with insects of certain kinds to see whether these could retain the virus of poliomyelitis in a virulent condition in their bodies for any length of time. This has been done either by allowing the insects to feed on bits of infected spinal cord, or by allowing them to suck the blood of infected monkeys. After varying periods the insects were then ground up in a mortar and injected intracerebrally into monkeys. Positive results have been obtained in the case of house flies, bedbugs, and possibly with fleas, but only negative ones with several species of mosquitoes and lice. In all these cases, it must be remembered that the pulverized insects were injected into the brains of the monkeys, so that these results do not have a very direct bearing on the epidemiology of the disease.

The fact that Stomoxys does not bite children so very frequently suggests that perhaps poliomyelitis may possibly be regularly spread from some domestic animal which acts as a reservoir for the virus, and it has long been suspected that this disease in man may bear a relation to some paralytic disease of animals. On the other hand, the numerous mild cases which are usually regarded as abortive poliomyelitis may serve as reservoirs as well as the paralytic cases, and then the frequency with which Stomoxys bites might account for the incidence of the disease without any connections with animals. These are matters which will require much further study.

PRESIDENT W. D. HUNTER: This paper is open for discussion.

Mr. C. L. MARLATT: I would like to ask a question, and that is, do I understand, from the diagram exhibited showing occurrence of the disease in the winter months (December, January, February, etc.), that the disease originated in these months, or are these cases carried over from the summer?

Mr. C. T. BRUES: We have no evidence except that the winter development of the disease is rather more than might be expected from the rarity of the fly in the winter.

Mr. C. F. HODGE: We have been working on the habits of this insect and are surprised to find them in the winter in the stable biting animals.

MR. BRAIN: I think Prof. Brues and his colleagues have made a very important advance in the subject of medical entomology by the discovery of the connection between *Stomoxys calcitrans* and Poliomyelitis, but I feel that a further step is necessary, and that is to ascertain how many bites of this fly are necessary for the transmission. In these experiments some 300 flies were used, but it is not known how many fed on any particular day, nor how many fed before infection.

In nature 300 bites are impossible as are 200, 100, or even 50. Twenty seem improbable to me, while any number up to 10 is quite possible. Stomoxys seems very fond of feeding around the ankles, and I have seen two feeding on a child who was so intent on something or other that he did not notice the flies at all. In the case of heart-water, a disease of sheep, goats and cattle, which resembles Poliomyelitis in many ways, it has been found that one can be reasonably sure of getting the disease from the bites of three infected ticks. If such could be shown to be the case with Stomoxys in Infantile Paralysis, I think it would be a very important addition to the knowledge of the subject.

MR. C. T. BRUES: Just a word in regard to the fact that it actually takes a large amount of blood to transfer the disease from one animal to another by inoculation in this way. I do not think that a large number of flies would be necessary to transfer it in this way, much less that a single bite would produce disease in a merely mechanical way. I very much doubt if any of these monkeys could have been bitten by many infected flies.

MR. BRAIN: In connection with the inference that there is a cycle, part of which occurs in the body of the fly, from the fact that it requires a large amount of blood to cause the disease, it seems to me that I have heard of a similar case where a very small, or a very large amount of blood was necessary. I do not think the case is quite understood. That there is anything like a ten days' incubation period in the body of the fly seems to be disproved by the experiments of Anderson and Frost, for they inoculated the first monkey with the virus on October 3d, and the second on October 5th. Flies were fed a few hours after inoculation, and by October 13th they had two monkeys down from the inoculation and two from fly transmission.

MR. E. P. FELT: We have with us Dr. C. F. Hodge of Clark University, Worcester, Mass., who has developed a very successful flytrap and I think it would be very interesting if we could hear from him at this time.

PRESIDENT W. D. HUNTER: If there is no objection we will allow Dr. Hodge five minutes in which to discuss his flytrap.

A NEW FLY TRAP

By C. F. HODGE, *Clark University, Worcester, Mass.*

In our present war on the flies the quick, easy and effective method is to catch the breeders, or let them catch themselves. One pair put out of business in the spring may mean bushels less through the summer and fall.

For the large propositions, dairies, stables, slaughter houses, hotel kitchens, markets, and also for other flies, stable, horn, deer or black, bot flies, we need larger and other devices (See plate 1) than the small household flytraps.

Fig. 1 is a first model of a stable cellar window flytrap. It is 32 inches long by 16 inches deep and 12 inches wide, made to fit in the opening of a stable cellar window, the window being removed. The window in the sunniest corner, nearest the stock or manure is chosen, the one about which the flies naturally congregate, and gunny sacks are hung over the other windows. This remains, then, the only light window in the stable or stable cellar and all the flies of every kind go in or out and are caught going or coming. The figure shows the trap after it has been in position for one week at the Worcester Home Farm.

Fig. 2 shows the same trap after the flies have been emptied and measured. This gives more clearly the construction of the trap. The essentials are also given in cross section in Fig. 3, in the diagram fastened to the end of the trap. At the bottom is a crack, about a quarter inch wide, running the length of both sides. This crack admits the flies to a space covered by a ridge or roof of screen wire with holes large enough for flies to go through (punched with an ice pick) every two inches. Large pans of fly bait—fish heads, poultry cleanings, brewers' waste, blood, or anything available which is found on the premises to most powerfully attract flies can be set on the bottom board—and thus establish a whirlwind focus for all the flies about the place. The other essential in the construction is the fold, or folds in the screen walls. These are simply folds, or open pleats running horizontally across the trap, pointing upward and inward. The flies, in trying to get in or out of the window collect in these folds, run back and forth in them until they pop through one of the holes which occur every two inches and they have never been seen to find a hole on the convex, inside, surface of the wrinkle and crawl down and out again.

Fig. 4 shows the trap in position. A cow is close inside this window. The sun shines directly on her, making this a very bright window in an otherwise dark basement. The trap was set in the window, as shown in Fig. 4, from about July 1st until November. It was not baited at all. It picked up about five quarts of flies, 90 per cent of which were stable flies, practically all that appeared on the place. The rest were chiefly horn flies and a single bot fly. There were very few house flies or blow flies, because these had practically all been caught earlier in the season with baited traps. One morning I found the trap swarming with mosquitoes, which had evidently tried to

get in at the cow during the night. A similar trap set in a stable window on a farm on the Magothy River, Maryland, the stable standing in the edge of the woods near a spring and brook, caught thousands of the black or deer flies which were troubling the stock.

In Figs. 1 and 2, which, as stated, are of a first model, it would have been better to have made the folds nearer the top, since the week's catch has choked most all the entrance holes with dead flies.

Here is a trap, the simplest in construction I am able to imagine, which any farmer can make with a little box lumber and screen wire, which will pick up the breeders as fast as they come to the premises, not only of the common house flies but stable and horn flies, black flies and mosquitoes and possibly bot flies. It is still in its experimental stages, but it looks as if it might help to solve some of our most pressing fly problems.

THE STABLE FLY (STOMOXYS CALCITRANS L.), AN IMPORTANT LIVE STOCK PEST

By F. C. Bishopp[1]

The stable fly has long been known as an insect injurious to domestic animals. Considering its almost cosmopolitan distribution and close relation to man, it is strange that so little information has been published on the species. For about half a century practically nothing except unimportant and scattered notes were published on this insect until the appearance of Doctor Newstead's work on "The Life History of *Stomoxys calcitrans* Linn." published in the *Journal of Economic Biology* in 1906. Since the appearance of this paper the important work of Professor Porchinsky, "Recherches Bibliogiques sur le *Stomoxys calcitrans* L. et Biologie comparée des Mouches Coprophagues," was published in 1910. A note of much economic interest was also published in 1909 in the *Bulletin de la Société National d'Acclimation de France* by Lucien Iches.

The recent attention which has been given to the rôle played by insects in the transmission of disease has led many investigators to consider the possibility of Stomoxys acting as vector of a number of diseases of live stock and man. The work of several investigators indicates that the stable fly takes a more or less important part in the transmission of surra of domestic animals, a trypanosomiasis in cattle in Portugese East Africa, souma (*Trypanosoma cazalboui*) of the ox, horse and sheep, *T. pecaudia* of hogs, cats, etc., and anthrax in domestic animals and man. Other workers believe that the fly may in some

[1] Published by permission of the Chief of the Bureau of Entomology.

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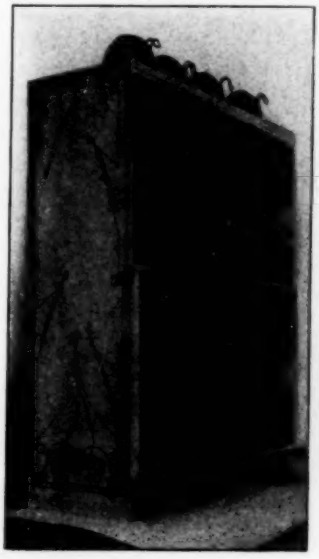

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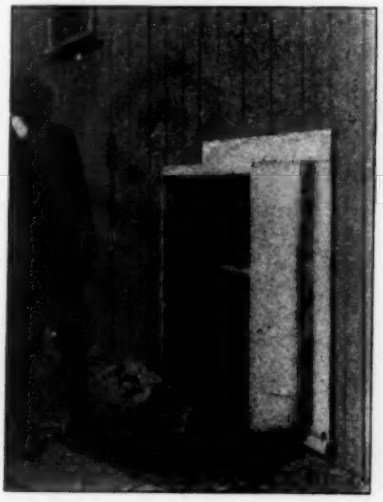

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Fly Traps

cases be connected with the transmission of septicemia in man, glanders in horses and other animals and certain other maladies. In this country the recent work of Brues and Sheppard on the apparent etiological relation between Stomoxys and poliomyelitis and the work of Jennings and King pointing toward the connection of the stable fly with pellagra transmission has had the effect of greatly stimulating the interest of entomologists as well as medical men in the study of this insect, and its possible relation to the transmission of various diseases, the etiology of which has not been fully elucidated. As is now generally known, the conclusions of Brues and Sheppard have been greatly strengthened by the work of Rosenau which demonstrated that the stable fly can transmit poliomyelitis in monkeys. The results of Rosenau have been corroborated by experiments along the same line conducted by Anderson and Frost of the United States Public Health Service.

An Unusual Outbreak of the Stable Fly

About August 14 reports of the occurrence of this species in unusual numbers began to be received from several points in north Texas. The flies appear to have become seriously numerous about August 12, and from that date until the end of August the outbreak continued at maximum severity. The abundance of the insect gradually became less until the middle of October, although an unusual number of flies were present from that date until about the middle of November.

An investigation quickly determined the fact that the flies were breeding in great numbers in straw stacks. The relation between straw and the abundance of the stable fly in this outbreak very closely simulated that described by Professor Iches as occurring in Argentina in 1898, although at the time this investigation was made Professor Iches' work was unfamiliar to the author.

Territory Affected

A survey of the territory made by the writer, assisted by Mr. J. D. Mitchell, showed that the great abundance of the fly was practically co-extensive with the area where grain was extensively produced this year. The abundance was found to be largely governed by the number of straw stacks in a given district. Although flies were found to be exceptionally numerous in areas where practically no oats or wheat were grown, usually such localities were not removed distantly from grain growing areas. The center of greatest abundance was in Grayson, Cook, Collin and Denton counties in northern Texas, however, the severe injury extended as far south as Hill county and west to

Wichita county. In Oklahoma the outbreak was much less severe and, as in Texas, appeared to be confined to localities where grain was extensively grown.

Character of Injury and Losses

Injury to live stock was brought about in a number of ways. Probably the "worry" due to the attack of great numbers of the flies was the most serious and this was a contributing factor to all of the losses sustained. During the period of greatest abundance all live stock were compelled to keep up a constant fight against the flies from daylight until dark. Whether the animals were being driven in small towns, on country roads, worked in fields, or kept in stable or pasture, the flies sought them out and kept up a continual attack. In many cases both horses and cattle became so weakened from this continual worry that they largely gave up fighting and flies swarmed on them in countless numbers. In a number of such cases animals that were not given attention succumbed to the injuries. The loss of blood during the outbreak was by no means a small matter as in many instances as high as a thousand flies were estimated to be present upon a single animal at one time. It was also found that as fast as the flies became filled with blood they would leave the host for a period in order to digest their meal and then renew the attack. It will thus be seen that the blood supply of animals in the worst infested territory must have been heavily drawn upon.

Another, and probably the most important source of loss through the actual death of animals, was the bringing on of acute Texas fever in cattle which already harbored the disease organism in their blood. The development of the disease in these animals was analogous to that which some times occurs in herds which are shipped long distances, exposed to very unfavorable climatic conditions or otherwise weakened, thus bringing on acute Texas fever. In the instances observed the animals were greatly weakened from fighting the flies as well as from loss of blood, thus the disease was given a good opportunity to take hold.

The lessening of the milk supply in all milk cows throughout the affected area was an important source of loss. Dairymen who kept close account of their milk production found that after the advent of the flies their milk output was reduced from 40 to 60 per cent, and in a few cases the cows were completely dried up. Reliable dairymen also assert that since the subsidence of the severe invasion the cows have never returned to their normal milk production.

The loss of flesh in all animals in the fly zone was very noticeable.

Work teams were found to have fallen off from 10 to 25 per cent in weight and fat cattle were in many cases made extremely poor.

The stamping of horses often caused lameness. Swollen and stiff joints were commonly produced by animals standing too long in water to escape the flies.

Another source of loss to farmers was their inability to proceed with their usual farm plowing and other operations at the proper time owing to the impossibility in many cases of working teams in fields. In a number of cases animals were driven frantic and ran away with buggies or wagons or if free in fields often became injured by running into wire fences.

It is difficult to estimate the entire loss due to this outbreak. It is conservatively estimated, however, that in north Texas over 300 head of cattle, mules and horses were killed directly or indirectly by the flies. This loss might be reasonably placed at $15,000, while the loss from other sources far surpassed this death loss.

Importance as a Pest in the United States

Inquiry has elicited the fact that outbreaks of a nature similar but not so severe as the one which occurred in 1912 have been experienced in north Texas a number of times previously. Flies were said to have been extremely abundant in north-central Texas during the latter part of the summer of 1867. Another unusual occurrence of the fly was in 1894 or 1895, and in 1905 the fly was very injurious in certain localities. An investigation of conditions in Kansas and Nebraska indicates that the fly is a pest of more of less importance every year in the grain belt of those states. In some localities in these states it was much worse than usual in 1912. Statements made by farmers in South Dakota and Georgia agree with the information secured in Kansas and Nebraska, and in southern Louisiana the pest was unusually abundant during the late fall of 1912. In Mississippi and South Carolina it occurs commonly and sometimes becomes a considerable pest of live stock. From statements published by Lugger and Washburn this insect must be a pest of importance in Minnesota. Investigations made in central Florida indicate that it is seldom of importance as a pest in that section. Prof. C. P. Gillette says in a recent letter "possibly the common stable fly is really the worst pest (of live stock in Colorado) on account of its being so abundant and ever present." Prof. J. M. Aldrich has given the information that the stable fly is a troublesome pest of cattle in Idaho, and Prof. R. W. Doane has made a similar statement regarding conditions in California.

Hosts

The stable fly does not restrict its feeding to any special hosts. It has been found to feed readily on practically all warm blooded animals, however, certain animals on account of their protective coverings or habits are rather less subject to its attack than are others. Mules appear to be very susceptible to attack and much worried by the presence of the fly.

Horses and cattle are both greatly annoyed. The nervous individuals, however, appear, on account of their frequent movements, to drive many of the flies away. Sheep and goats are both attacked on the legs, but few flies are able to become completely engorged on these animals. Hogs are also commonly bitten, the flies often settling in great numbers just behind the ears. Dogs, cats and chickens have also been seen with flies feeding upon them. Thin haired dogs are exceedingly susceptible to injury and have frequently been seen with blood trickling from the backs of their ears where flies are to be seen most frequently. It is only rarely that the fly attacks poultry, on account of the small surface exposed and the quick movement of the birds when attacked. Man is far from being immune from the attack of this pest. Owing to the lightness with which they sit on the exposed portion of the body and the quickness with which the beak is inserted, they often succeed in piercing the skin though seldom are allowed to become engorged. It has also been observed that they can readily penetrate moderately heavy clothing.

Action of Animals Attacked

As has been stated, the fly usually greatly annoys most animals upon which it attempts to feed. A few of the less nervous individuals permit the flies to engorge without strenuously fighting them, while others may be driven almost frantic. Animals free in pastures have been seen to exhibit various protective actions. When pools of water are within reach they usually enter the water and either lie down or wade into the deep water so as to be largely covered. If only mud is accessible they often stand and lie in this and thus become more or less coated and protected considerably from attack. In open pastures the animals usually come together in a close bunch on a knoll where the breeze is strongest, and there remain for hours stamping and going round and round in an effort to get protection by contact. When shades or stables are accessible the animals often congregate in these, and could hardly be induced to go out to graze for fear of the hordes of flies. Hogs and sheep exhibit habits similar to those of horses and

cattle in regard to securing protection by entering mud or assembling close to sheds or stables.

Life History and Habits

Breeding Places. A somewhat careful examination has shown that the stable fly breeds in the following substances: The list is given in the approximate order of importance. The straw of oats, rice, barley, wheat, horse manure, lot manure and cow manure. It has been determined that pure horse and cow manure are much less attractive to the fly than when a considerable quantity of straw is intermixed. By lot manure is meant the scattered, finely pulverized manure which occurs in barn lots. Examinations of accumulations of weeds have failed to show the presence of Stomoxys larvæ. This is also true of alfalfa hay which was in a rotting condition. The fly has been bred in broken-up upland hay such as is found around the base of stacks or in barns where feeding is done. The vast majority of flies, however, undoubtedly breed in decaying straw, either pure or mixed with manure.

An examination of oat and wheat straw stacks during the latter part of August and early September, 1912, showed that far more larvæ were developing in oat straw than in wheat straw. The former appeared to be more suitable because of its compact texture after being wet and the greater amount of leaves. Most of the flies were breeding in the lower portions of the stacks although a few pupæ were found on the very top of a stack fifteen feet high. After the larvæ develop they show a tendency to work downward, or at least to follow the moisture as the surface of the stack dries. Pupation occurs anywhere in the straw but pupæ are usually more numerous between layers of straw or between the straw and the surface of the ground. At Addis, La., the writer found large numbers of Stomoxys breeding in stacks of rice straw, the conditions under which they were found being quite similar to those in oat straw stacks.

Larvæ have often been observed when small to penetrate between the epithelium layers of the stalk or leaves of grain when moistened in the straw stacks. As the larvæ become larger they often enter the straws and feed within and pupation frequently occurs in this position.

Habits of the Adult. The adults, both male and female, are ready to partake of a meal of blood as soon as the body and mouth parts are thoroughly hardened after emergence. The host appears to be located largely by sight and on cattle the fly has been frequently seen to alight on the back and as soon as disturbed by the switching of the tail it flies directly to the outside of the forelegs just below the

knee. This is the situation usually chosen by the fly in feeding on bovine hosts, apparently on account of the relative freedom from attack by the tail or mouth of the host and the comparative shortness of the hair which permits of easy penetration. On horses the flies feed in greatest numbers on the lower parts of the legs, sides of the neck and under the belly, although when an animal is in harness they commonly feed on all parts of the body not readily reached by the tail.

The bite of the fly is quite painful, the first insertion of the beak being accompanied by a sharp, piercing pain. As the proboscis is worked in further there is usually a series of more or less sharp pains accompanied by itching. After the beak is inserted and feeding begins there is usually no discomforture. Feeding is ordinarily completed in from two to five minutes after the beak is inserted. After the fly has once begun drawing blood it is usually not easily disturbed and continues to feed until replete. When the fly is well filled excretion of from one to several minute drops of a clear liquid usually takes place. When the beak is withdrawn the fly goes through a series of cleaning operations and flies away at the first sign of motion of the host. Following the withdrawal of the beak a drop of blood usually exudes. Little or no itching follows the bite although sometimes a minute reddish spot is visible for a day or two. When fully engorged the abdomen is tremendously distended and flight is comparatively slow and heavy.

For some time after feeding the flies are comparatively sluggish and remain motionless on any nearby object. In open fields and along roadways they were often seen during the recent outbreak in great numbers beneath the surface of leaves of plants where they had gone for protection from the sun during hot days, and hundreds of specimens were often to be seen on the foliage of trees up to a considerable height. Hundreds of them have often been observed resting on the shady sides of barns and silos. During this resting period the blood digests rapidly and the voiding of the clear liquid excrement occurs at intervals of a few seconds. After a few hours this excrement becomes darker and less liquid, leaving a black spot where it dries. During the outbreak described the weather boarding on houses and barns was in many cases thickly spotted with this excrement.

During moderately cool weather feeding usually takes place each day. When the weather is warmer digestion proceeds faster and flies may engorge twice during one day. In some cases individuals which are disturbed during their meal will persist until they have become completely engorged, while others which are less persistent finally leave the host when only partially fed. Flies have been observed to pass

freely from one animal to another many times before becoming replete, thus giving an opportunity to convey disease mechanically.

On account of the probable relation of this insect to the transmission of a number of diseases, the study of its feeding habits in relation to climatic conditions is important. It has been found that adults will feed in midday during extremely hot weather and also when the temperature is as low as 55 degrees Fahrenheit. The minimum feeding temperature may be even lower than this. During rainy weather the flies are largely driven into sheltered places. This accounts for the presence of adults which has been observed heretofore in the habitations of man at such times. The flies have not been observed to be more persistent in their feeding during cloudy weather than in clear weather although they continue to attack hosts during showers or cool, drizzling rains. The fly may also bite by artificial light when free in a room.

Reproduction. In a large series of tests flies have been found never to deposit before the third feeding on blood and usually four engorgements are necessary. There is no indication that reproduction ever takes place unless blood is engorged, however it is a common habit of flies to partake of other liquid food. During deposition they frequently feed upon the moisture on rotten straw and also have been observed to take up moisture from manure as well as to drink freely from plain or sweetened water when it is supplied to them in confinement.

After the third or fourth feed, when the blood has been digested, the flies seek suitable places for depositing their eggs. Deposition has been observed both in confinement and in the field. Upon opening a straw stack which had become dry on the surface, thus exposing the rotting portions beneath, the flies immediately assembled and sometimes crawled down into the straw to a depth of several inches and began laying eggs. These may be laid singly or in bunches of as many as twenty-five or thirty. The ovipositor is greatly extended and used as a tactile organ in order to find a orevice in which to place the eggs. During active depositon from seven to nine eggs are deposited per minute and the entire mass is usually deposited in less than half an hour. Immediately after depositing the females are ready to feed again and this feeding is usually followed within a day by another deposition. The greatest number of depositions observed by a single fly was three, a total of 278 eggs being deposited. Frequently two feedings are necessary after a given deposition before another lot of eggs is laid. As the temperature becomes lower greater numbers of feedings are required to produce the same number of depositions. In one instance a female was engorged more or less completely fourteen

different times and deposited two lots of eggs. In another instance a female which did not have access to males was engorged twelve times, no eggs being deposited.

TABLE I.—RECORDS OF FEEDING AND DEPOSITION

First Feeding Period	Deposited		Date Fed	Deposited		Date Fed	Deposited		Total No. Eggs
	Date	No. eggs		Date	No. Eggs		Date	No. eggs	
Oct. 5-7	Oct. 8	71	Oct. 8	Oct. 9	105	Oct. 10	Oct. 11	102	278
"	"	99	"	"	97	"	last	"	196
"	"	89	killed	"	"	"	"	"	89
"	"	122	Oct. 9	last	"	"	"	"	122
"	Oct. 9	96	killed	"	"	"	"	"	96
"	"	66	Oct. 9	Oct. 11	109	last	Oct. 13	51	175
"	"	"	"	"	57	Oct. 11	died	"	108
Oct. 25-29	Oct. 30	50	Oct. 30	Nov. 1	23	Nov. 3	"	"	73
"	"	109	"	Oct. 31	120	Nov. 1	"	"	229
"	"	111	"	Nov. 1	109	Nov. 3	"	"	220
"	"	"	Oct. 31	Nov. 3	78	"	Nov. 4	88	166
Oct. 25-30	"	"	Nov. 4	Nov. 5	20	Nov. 6	Nov. 7	52	72

The accompanying table shows the number of eggs deposited by several females upon which egg counts were made. Other individuals

fed at the same time failed to deposit any eggs. Several of the flies, the deposition of which is recorded in the table, fed one or more times after the last deposition recorded but did not deposit subsequently.

Experimental evidence indicates that fertilization does not take place until after the flies have partaken of blood. Copulation has been observed but a very few times. In the instances noted the act took place some time after the flies had been fed, the duration of the act being about five minutes. In one instance a fly deposited fertile eggs without copulating with the male after the first deposition.

Longevity of Adults. Flies kept in close confinement without food or water die within two days. When water and sugar syrup were supplied to flies in a cage about one foot square a single female, of a lot of about fifteen males and females, survived for twenty-three days. Individuals which were fed on blood at rather short intervals lived seventeen days. It has also been noticed that when fruit or moist straw is supplied the length of life of the flies frequently reaches ten days.

Duration of Stages. The length of the egg stage has been found to vary from one to four days. Temperature and humidity, as well as the length of time eggs are retained by the female, appear to markedly affect the rapidity of incubation. The larval period has been found to vary from about eleven to over thirty days. Records made during cold weather would doubtless show this stage to be much longer. The suitability of food also decidedly affects development. As is shown in the accompanying table the minimum developmental period from egg to adult ranged from twenty-three to thirty-two days, according to the character of the food supplied. The pupal stage varies from six to about twenty days and the total period from egg to adult from nineteen to over forty-two days.

It has been found that abundance of food hastens development considerably. This is brought about in two ways, namely, by enabling the larvæ to choose suitable portions of the food, and where there is a large amount of straw or other food material in a pile the heat generated stimulates development. Even during the late fall in north Texas, when the minimum temperature reached thirty degrees, frequently the straw where larvæ were found to be developing was very warm. In larger stacks this heat may persist through the winter.

Hibernation. No notes have been made on hibernation but examinations of stacks in the middle of December show an abundance of larvæ in various stages of growth and many pupæ. Adults have also been found active and feeding on animals on December 18. It is thought that adults may be more or less active in southern latitudes during warm periods throughout the greater part of the winter, and

no doubt emergence of adults continues during most of the winter months. Probably most of the individuals which successfully hibernate in the latitude of Dallas pass the winter in the larval and pupal stages.

TABLE II.—DURATION OF STAGES AS RECORDED AT DALLAS, TEXAS, IN 1912

Eggs Deposited	Hatched	Incubation Period	Pupated		Larval Period	Adults Emerged		Pupal Period	Total Period—Egg to Adult
			First	Last		First	Last		
		Days			Days			Days	Days
..	..	..	Sept. 9	..	..	Sept. 17	Sept. 18	8-9	..
..	..	..	Sept. 10	..	..	Sept. 18	Sept. 20	8-10	..
..	..	..	Sept. 11	..	..	Sept. 19	..	8	..
Sept. 14*	..	..	..	..	..	Oct. 7	Oct. 15	..	23-31
Sept. 14*	..	..	..	..	..	Oct. 11	Oct. 19	..	27-35
Sept. 14*	..	..	..	..	..	Oct. 10	Oct. 20	..	26-36
Sept. 14*	..	..	..	..	..	Oct. 16	Oct. 21	..	32-37
Sept. 14	..	..	Oct. 1	..	17	Oct. 7	..	6	23
Sept. 15	..	..	Oct. 1	..	16	Oct. 7	..	6	22
Sept. 15	..	..	..	..	..	Oct. 4	..	..	19
Sept. 22	Sept. 24	2	..	..	..	Oct. 12	Oct. 19	..	20-27
Sept. 23	Sept. 25	2	About Oct. 6	Oct. 12	11+-17	Oct. 12	Oct. 18	6+	19-25
Oct. 8	Oct. 9	1	Oct. 28	Nov. 1	19-23	Nov. 5	..	8	28
Oct. 9	Oct. 11	2	Oct. 27?	Nov. 1	16?-21	Nov. 4	Nov. 21	8-20	26-43
Oct. 11	Oct. 13	2	Nov. 6	After Nov. 22	24-30+	Nov. 17	After Nov. 22	11-16+	37-42+
Oct. 30	Oct. 31	1	..	..	..	Dec. 1	..	..	32

* The first of this series of records was made with rotten oat straw as a breeding medium; the second cow manure; third cow manure pulverised in lot; fourth broken up hay.

Relation Between Grain Crop, Rains and Abundance of the Fly. As has been pointed out, this insect is usually much more numerous during the late summer and early fall months. When we come to understand the breeding habits of this species this condition is readily explained. A study of the recent outbreak in Texas clearly shows that the unusual abundance in August and September was due to the large crop of grain, incidentally producing a great number of straw stacks, combined with the unusually heavy rains in early August (at Dallas, Texas, 6.47 inches of rain fell). Many stacks were recently thrashed and, being loosely piled, absorbed the rains as they fell. In a few days the entire mass became rotten and heated and thus afforded precisely the conditions which are most desirable for the reproduction of Stomoxys. It has also been found that during other years of unusual abundance of this pest, the large grain crop and summer rains have been the principal contributory factors.

In Texas the activity of many adults has been observed rather early in the spring. On May 18, 1912, the fly had become sufficiently numerous at Dallas to greatly annoy cattle. During the latter part of May it was found by Mr. Wood to be present in numbers at Abilene, Texas. The flies which appear in the spring and early summer breed largely, no doubt, in straw stacks of the previous year and in straw used in feeding and bedding animals.

Natural Control

Climatic Influences. As has been mentioned, the presence or absence of moisture in the breeding places of this species has a very potent influence on development. The larvæ are able to withstand a great amount of moisture, often feeding on straw which is saturated with water and thus being themselves largely submerged. It has been found, however, that where there is a considerable depth of water above the larvæ they soon stop feeding and become dormant, not being able to stand this condition more than a number of hours. The young larvæ are much more susceptible to injury by extremes of moisture and temperature than are the well developed ones. In the case of the latter pupation is often hurried as a result of these exposures. Larvæ have often been observed, when quiescent on account of lack of moisture, to become active and resume feeding after water is supplied. The pupæ are much more resistant to the effects of both moisture and temperature extremes. Light also has a very marked influence on the development of larvæ, particularly when they are small. In no case have larvæ been induced to complete development when kept in tubes and exposed to bright light. As has been discussed under habits

of the adult, feeding may take place at very high temperatures. Below 55 degrees the flies become more sluggish and show less desire to feed and dormancy appears to occur between 40 and 49 degrees. Temperatures of 27 degrees are not fatal to the adults. When dormant flies are placed in the direct sun they become active much more quickly than when kept in the shade at the same temperature.

The drying out of straw stacks to a depth of six or eight inches largely prevents the deposition of eggs in these situations, the stacks under these conditions being unattractive to the adult fly.

Parasites and Predaceous Enemies. In the breeding of material from various points in the Southwest, parasites have been found in pupæ in a number of lots of Stomoxys. Two small Hymenopterons of the family Pteromalidæ have been found in numbers. One of these is *Spalangia muscæ* and the other is in a different genus although a definite determination of it has not been made. *S. muscæ* has been bred from Stomoxys pupæ collected in a horse manure pile at Wellington, Kans., by Mr. E. O. G. Kelly and the writer, a few specimens from material collected in straw at Gainesville, Texas, and large numbers from straw heavily infested with Stomoxys at Dallas, Texas. Pupæ obtained in rice straw by the writer at Addis, La., were also parasitized but the adults have not yet emerged. In a quantity of straw kept in the laboratory yard at Dallas for the purpose of breeding Stomoxys, it was estimated that about 40 per cent of the pupæ were parasitized by these two species. This estimate was based on an examination by Mr. Harry Pinkus and the writer of all the pupæ in the straw, which numbered some 2500. In breeding experiments it has been determined by Mr. Pinkus that parasitism always takes place in the pupal stage. Both of the parasites have been found to attack the pupa of the house fly (*Musca domestica*) and the horn fly (*Hæmatobia serrata*), as well as other mucid pupæ.

During the outbreak of this insect predaceous insects were present in large numbers. Adults of Stomoxys were found to be captured by several species of Asilidæ which were present in great numbers around straw stacks. Several species of spiders were observed in the act of capturing and devouring adult flies. Two or three species of mites were also found to be enemies of the immature and adult stages of Stomoxys. In manure and straw histerid beetles were among the more important predators. Chickens and other domestic fowls, hogs and mice were found to destroy the larvæ and pupæ of this insect in great numbers. The chickens and hogs were attracted to the straw stacks mainly by the presence of grain, but they evidently devoured large numbers of the immature stages of the fly while searching for grain.

Artificial Control

Destruction of Breeding Places. Since straw stacks have been found to be the principal breeding places of this insect in the grain growing belt, attention should be given to the care of straw as the most important step in control. In general, it is the practice throughout the grain belt for farmers to stack the straw by the use of self-stacking threshing machines. After the threshing is done no attention is paid to the care of the stack until a year or two after when in some instances it is burned, in other cases the new straw is stacked on top of the old piles. These practices are bad, not only on account of the breeding of Stomoxys and other flies, but the full manurial value of the straw is not secured and a considerable amount of valuable land is occupied continuously by the large and often scattered stacks of straw. In many cases it has been found that these stacks occupy as much as a hundred yards square of tillable soil. On account of the fact that straw is depended upon by many farmers to supplement their other food supply for live stock during the winter, a general recommendation to burn the stacks immediately after threshing is not practicable. All the straw which is not required for winter feed for cattle should be destroyed by burning or scattered over the land soon after threshing and plowed under subsequently. Oat straw is usually used for feeding purposes. It should be remembered that this also forms the most favorable breeding medium for Stomoxys. It is therefore recommended that the straw for feeding and bedding purposes be baled and stored under cover. Where this is not practicable the stacks should be rounded up so as to make the top largely rain proof and the sides almost vertical.

It should be borne in mind that under conditions similar to those which prevailed during the summer of 1912 the straw stacks are largely rendered unfit for food owing to the thorough wetting by August rains, and are, therefore, of little value except for fertilizing purposes. In such instances where the flies are already breeding in uncared-for stacks they should be promptly burned or scattered. If the scattering is done thoroughly the exposure of the straw to drying and light will effectually stop the breeding of the flies.

Where headers instead of binders are used the straw question is less important as most of the straw is left in the field and later plowed under. The destruction of the chaff and the short straw taken by headers can readily be disposed of as indicated above.

The use of poisons is not advisable as quantities sufficient to permeate the stacks and kill the larvæ would be very dangerous to stock

and equally as expensive as the disposition of the stack in some other way.

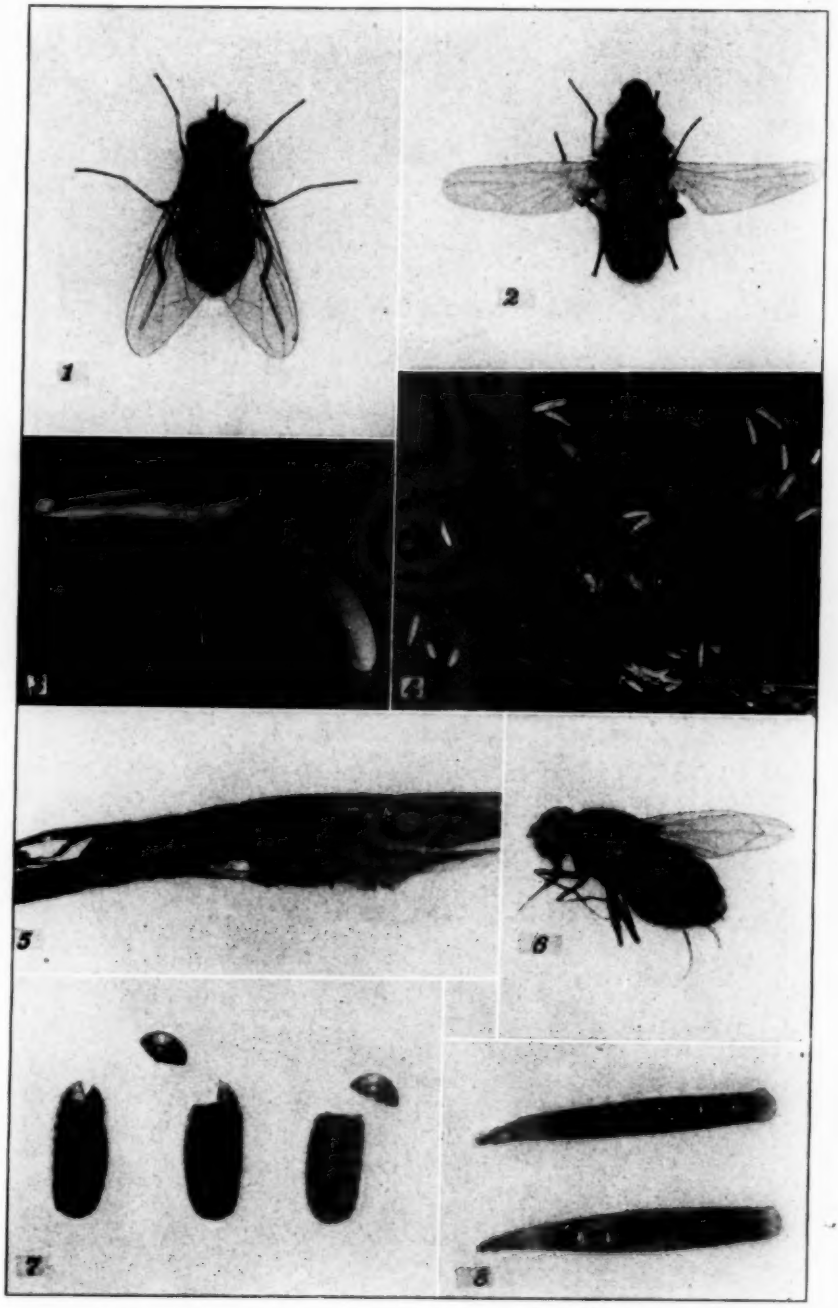
Whenever manure is mixed with any amount of straw it may be suspected of forming a breeding place for Stomoxys. The thorough scattering of manure at regular intervals as is recommended for the control of the house fly is effective in stopping the breeding of Stomoxys. Accumulations of straw, hay or manure should not be allowed about fence corners and barns as all of these situations are utilized by the stable fly for breeding when large manure piles and straw stacks are not available.

PROTECTION OF STOCK. The protection of work animals by means of coverings lends much protection from the attack of this pest. The most effective and inexpensive covering observed during the recent outbreak was a blanket made of a double thickness of burlap so arranged as to completely cover the back, sides and neck, and the covering of the legs by means of trousers slipped on over the feet. The latter can be made of burlap or old trousers be utilized. When fastened together over the shoulders and back or attached to the harness, the animal is almost completely protected from the flies. Leather nets or other coverings should also be applied to the head.

A large number of repellent decoctions were tried during the recent outbreak. None of these gave more than temporary relief and some proved injurious to the animals. A mixture of fish oil, oil of tar and oil of pennyroyal with a little kerosene added proved to be the most efficacious.

Where stables are exceedingly dark they offer much protection from fly attack. The thorough screening of barns also gives a large degree of immunity. In this case the flies should be brushed off the animals when they enter the barns by means of nets over the doorway or by brushing the animals with sacks as they enter. Screened barns have a great advantage over dark ones because they admit light and air whereas darkened barns are extremely hot in summer.

Plowing rather deep, narrow trenches offers much protection to hogs from fly attack. The sides of these trenches may be oiled with petroleum. By this means the hogs, which readily take to these trenches when attacked by the flies, become oiled on their sides and backs which adds to their protection. This form of trench may also be used to protect sheep as it allows them to cover their legs where the flies can best reach them.



Stable Fly.

1

2 Stable Fly Conditions.

Proceedings of the Eleventh Annual Meeting of the American Association of Official Horticultural Inspectors

The Eleventh Annual Meeting of the American Association of Official Horticultural Inspectors was held at Cleveland, January 2 and 3.

For convenience, the business transacted at the meeting will be reported first, which will be followed by the papers and discussions.

PART I

The first session was held in the parlors of the Hotel Euclid, Thursday evening, January 2. The meeting was called to order at 8 p. m. by President T. J. Headlee, with T. B. Symons, Secretary. Among the inspectors and visitors were present the following:—

T. J. Headlee, New Brunswick, N. J., H. E. Summers, Ames, Iowa, F. L. Washburn, Minneapolis, Minn., George G. Atwood, Albany, N. Y., W. E. Britton, New Haven, Conn., T. B. Symons, College Park, Md., C. L. Marlatt, W. O. Orton, Peter Bissett of Department of Agriculture, Washington, D. C., A. F. Burgess, Melrose Highlands, Mass., P. A. Glenn, Urbana, Ill., C. H. Baldwin, Indianapolis, Ind., George A. Dean, Manhattan, Kans., L. M. Peairs, Morgantown, W. Va., Enos B. Engle, Harrisburg, Pa., W. J. Schoene, Geneva, N. Y., P. J. Parrott, Geneva, N. Y., L. Caesar, Guelph, Ontario, Henry H. Severin, University of Wisconsin, Madison, Wis., H. C. Severin, Brookings, S. D., S. J. Hunter, Lawrence, Kans., Alfred C. Burrill, Madison, Wis., S. C. Clapp, Department of Agriculture, Raleigh, N. C., R. W. Braucher, Kent, O., H. J. Quayle, Berkeley, Cal., W. W. Yothers, Orlando, Fla., W. D. Hunter, Washington, D. C., Mel T. Cook, New Brunswick, N. J., J. G. Sanders, Madison, Wis., E. P. Felt, Albany, N. Y., H. E. Morris, Bozeman, Montana, Y. H. Tsou, Urbana, Ill., H. T. Osborn, Columbus, O., R. S. McKay, Owensville, O., E. W. Mendenhall, Columbus, O., C. W. Waid, Springfield, O., H. D. Leach, Delaware, O., J. H. Dayton, Painesville, O., H. E. Evans, Columbus, O., A. W. Morrill, Phoenix, Ariz., T. H. Parks, Greenwood, Miss., J. F. Zimmer, Washington. D. C., F. M. Rolfs, Ithaca, N. Y.

Plate 2.—*Stomoxys calcitrans*. Fig. 1.—Adult (dorsal view) enlarged x6.7. Fig. 2.—Fly soon after emergence showing ptilinum extended, enlarged x6.7. Fig. 3.—Eggs, enlarged x49. Fig. 4.—Eggs on rotten straw, enlarged x6.7. Fig. 5.—Pupæ within a straw, enlarged. Fig. 6.—Adult engorged with blood, enlarged x6.7. Fig. 7.—Puparia showing fractures due to emergence of flies, enlarged x6.7. Fig. 8.—Larvæ (upper, ventral; lower, dorsal view) enlarged x6.7. (Original Photos by H. P. Wood).

Plate 3. Fig. 1.—Cows in water to avoid the attacks of the stable fly. Fig. 2.—Horses with one form of covering used to protect them from stable fly attacks (Original Photos by F. C. Bishopp and H. P. Wood).

REPORT OF SECRETARY-TREASURER

The work of the Association has progressed satisfactorily during the past year:—New members have joined the Association, but there are several on the roll of the Association who have not paid their dues.

With the passage of the Plant Quarantine Law, there is an added necessity for an annual conference of State Horticultural Inspectors, to study and discuss the best means of conducting our work with justice to all parties.

The Association is now on a good working basis, and I hope that the proposal of affiliation as a section of the Association of Economic Entomologists will meet with the approval of the members of each Association.

In any event, I beg to be relieved of the duties of Secretary-Treasurer on account of increased demands on my time in Maryland. According to the by-laws, I believe there remains one more year of my term of office.

As your treasurer I submit the following statement, giving a balance to the treasury of $45.27.

Respectfully submitted,

T. B. SYMONS.

STATEMENT

T. B. SYMONS, In Account with American Association of Official Horticultural Inspectors.

By Balance			$16.27
By Dues (May to December)			44.00
Credit for bills not paid—1911 statement			12.00
			$72.27
1912:			
#1. Feb. 6.	To A. W. Myers, stenographic work	$4.50	
#2. April 7.	Jr. Economic Entomology, printing separates, legislative article	9.50	
#3. Dec. 20.	Anna E. McCarthy, stenographic work	6.00	
#4. " "	T. B. Symons, stamps	5.00	25.00
			$47.27
Debit by check returned			2.00
Balance to Dec. 21, 1912			$45.27

The report was accepted.

The Chairman of the Committee on Affiliation, Prof. T. B. Symons, submitted the report of the committee, which was similar to the report submitted by the committee to the Association of Economic Entomologists. See Page 20.

After a discussion the report was adopted.

After a discussion of the desirability of having uniform state laws, the President was authorized to appoint a committee to draw up a model law for presentation at our next annual meeting.

The President appointed Messrs. C. L. Marlatt, Franklin Sherman, Jr., and J. G. Sanders.

The following report of the Legislative Committee was adopted and the committee discharged.

REPORT OF COMMITTEE ON LEGISLATION

Mr. Chairman and Members of the Association:

Your committee begs to report that it coöperated with other committees of Associations interested in National Legislation, and with the Officers of the U. S. Department of Agriculture, in securing the passage of the Federal Plant Quarantine Law. Many meetings and conferences were held with parties interested while the bill was pending the last session of Congress. After an agreement regarding the provisions of the bill had been reached, the Officers of the Bureau of Entomology, especially Mr. Marlatt, were untiring in their efforts to have the legislation enacted by Congress.

While the bill as passed is not perfect, it is hoped that the discussion of this legislation at these meetings will be helpful in suggesting any amendments that may be necessary in the future, for the greatest protection to this country, against imported insects and diseases, with the least hardship upon the importers.

Respectfully submitted,

T. B. Symons.
E. L. Worsham.
H. A. Surface.

REPORT OF AUDITING COMMITTEE

Mr. Chairman:

Your committee reports that it has examined the books and vouchers of the Treasurer and found them correct.

J. G. Sanders.
W. C. O'Kane.

REPORT OF COMMITTEE ON RESOLUTIONS

Whereas, the establishment of the Federal Horticultural Board is a great advance in improving the horticultural inspection service of the United States, and believing that there should be the fullest possible coöperation between this Board and the State Inspectors,—therefore,

Be It Resolved: That we express our appreciation of the presence at this meeting of the members of the Federal Horticultural Board; that we are willing and desirous of conferring and coöperating with the Board so far as local conditions permit.

Be It Further Resolved: That we employ for inspectors when possible, men of a high standard of integrity and intelligence and of more ample training and experience with both insects and plant diseases.

Whereas, certain insects and plant diseases are considered dangerously injurious in some States or Countries and not in others, it seems necessary that some publication be issued giving brief illustrated accounts of the various pests,—

Be It Resolved: That the President appoint a Committee of three to confer with members of the Federal Horticultural Board and request the Board to issue such a publication.

W. E. Britton, *Chairman*.
George G. Atwood.
H. E. Summers.

The report of the Committee was adopted.

REPORT OF NOMINATING COMMITTEE

Mr. Chairman:

Your committee after considering the action taken by this Association and the Association of Economic Entomologists, recommends that Mr. J. G. Sanders be selected for permanent Secretary for our section. The First Vice-President, Prof. E. L. Worsham, of the Economic Association will serve as the Chairman for our next meeting.

Respectfully submitted,

F. L. Washburn.
T. B. Symons.
N. E. Shaw.

The report of the Committee was adopted, and it was moved and carried that the Secretary cast the ballot for the election of Professor Sanders for Secretary.

This concluded the business transacted at the meeting.

PRESIDENT'S ADDRESS

By T. J. Headlee, *New Brunswick, N. J.*

Fellow-members of the American Association of Official Horticultural Inspectors:

Your president desires to express himself as deeply appreciative of the honor that you have seen fit to confer upon him. It has not been customary for the chairmen of this body to make lengthy addresses and it is not purposed to violate the custom in this instance.

Your chairman desires to invite your attention to an interpretation of the duties of the horticultural inspection service based on a fundamental conception of the end it is to serve and to make certain suggestions for its improvement.

The origin and distribution of animal and plant species in a state of nature has been in progress from earliest time. Nature in the form of climatic factors and physical features has set the bounds of the distribution of each species. In general, species arise and distribute themselves as widely as these factors operating on them directly and through their food plants and their enemies, indirectly, will permit. It is, therefore, to be expected that, climate not forbidding, the insect and fungous enemies of the specific plant will usually be able to follow it to the ends of the earth.

When man began to transport plants from all parts of the world, he incidentally carried along their insect and fungous enemies. Considering our own country, the plants usually came fairly free from their enemies; but repeated importations finally brought them in sufficient

numbers to form destructive pests. Usually the damage done by them to their old food plants has been greater than that which ordinarily took place in the country from which they both came, and has continued to be so until their predaceous and parasitic foes have become sufficiently numerous, or native forms have learned how to use the pest or both. Not only have the injurious species imported with specific plants attacked these plants; but in some instances they have found native plants to their liking. Incidental to the importation of plants, species of injurious insects and fungous diseases not in any way injurious to the specific plants with which they came have been brought in. Some species coming to us in this way have proven very injurious to other species of useful plants.

If this process of distribution be allowed to go on it seems entirely probable that every injurious insect and every fungous disease will become as widely distributed throughout the earth as the climate will permit, because man has removed the physical-feature barrier.

It is the business of the inspection service to discover the injurious forms that are thus being distributed and to take such measures as will prove a barrier to their further spread. This duty the service has well understood and has tried to fulfill. Unfortunately, with very few exceptions, all efforts toward stopping the distribution of serious insect pests and plant diseases have resulted, or promise to result, merely in delaying the spread of the organism. This result has, of course, been due to a variety of causes; but chiefly to the fact that natural forces operate for twenty-four hours every day in the year and every year in the century, while horticultural inspection operates only intermittently. In the light of past experience, it seems probable that the distribution of every injurious insect and every plant disease will coincide with that of its food plants in so far as climate will permit, and that all the horticultural inspection service will be able to do will be to delay the distribution of dangerous species until their normal environment of enemies can be developed and efficient artificial measures for their control discovered. It is well to recognize our limitations and not allow ourselves in the heat of argument before committees on appropriations to promise eradication if only enough of the "sinews of war" is put into our hands.

Whether the inspector will or no, the general public and the fruit grower look upon his certificate as a guarantee of freedom from injurious insects and plant diseases. It seems likely that the time is not far distant when in his full capacity of nursery, fruit planting and fruit inspector, the official horticultural inspector will be held responsible by the public for the sort of fruit with which it is fed. Your present chairman is in entire sympathy with the contention of our ex-president

and fellow member, Mr. Franklin Sherman, Jr., of North Carolina, that the certificates which we issue should mean exactly what they say. The business should be so managed that the certificate should be a guarantee in fact as well as in opinion.

The official horticultural inspector clearly owes a service to the nurseryman, for he is an absolutely necessary factor. The inspector should so clean up the nurseries and their environs in his charge that clean stock from clean starts can be produced. He should make such arrangements that his nurserymen can obtain clean scions, buds, etc., from tested sources. Having made the production of clean stock possible, he should then see that every nurseryman produces that kind of stock.

The horticultural inspection service should see to it that the dealer in nursery stock handles only that which comes from clean sources and that the same regulation is enforced where the importer is concerned.

This past year has brought the enactment of a national inspection law, and some have this, the first year of its operation, found that it permitted them to protect their states better than has hitherto been possible.

The interrelation between the national and state arms of the inspection service should be one of courteous coöperation. The present method adopted by the Federal Horticultural Board of having inspections within the limits of the states made by state inspectors, is one to be commended and one that should be continued. A little more of personal contact between the administrators of the national and state laws would lead to better understanding of plans and aims, and is highly desirable.

The horticultural inspection service now needs to initiate a campaign of education on the danger of carrying plants in trunks, bags, or bundles in hand from one locality to another. This form of distribution we appear at present to have no other method of meeting.

There are many mooted questions concerning the importance of this or that insect and of this or that plant disease. This association should make some provision, as by means of a standing committee, for an annual summarizing of the status of information with regard to the importance of each of these insects and diseases to horticulture in the various states of this country. The first duty of such a committee would be to obtain by inquiry a concensus of opinion of the service on just what are the insects and diseases feared in the different sections of this country. The second duty would be to summarize and present the evidence on the dangerous nature of the doubtful forms, their present distribution, and the means of preventing their spread.

There is a fundamental weakness in the present inspection service in that too few of our inspectors are trained plant pathologists. A few states have already provided men thoroughly trained both in injurious insects and plant diseases, and your chairman believes that this association should go on record as favoring this type of service.

In closing these remarks it should be said:

1. That the general public and the fruit grower regard the inspector's certificate as a guarantee and the proper way to meet this responsibility is to make the certificate mean exactly what it says.

2. That the inspector should so clean up the nurseries and environs under his charge that his nurserymen can start with clean material and grow clean stock; that he should provide tested sources of growing material, and that he should then require his nurserymen to produce clean stock only.

3. That a standing committee from this association should be appointed for the purpose of summarizing the opinion of the service as to the seriousness of the various insects injurious to horticulture in the different parts of this country and for the purpose of summarizing annually the status of knowledge and opinion on the importance of insect pests and plant diseases about which there exists doubt, or that some other adequate provision should be made for placing this information in the hands of the inspectors.

4. That this association should go on record as favoring an inspection service composed of men properly trained in both injurious insects and plant diseases.

THE FEDERAL PLANT QUARANTINE ACT

By C. L. MARLATT, *Chairman Federal Horticultural Board*

QUARANTINE ORDERS

The act of August 20, 1912, was immediately effective as to certain quarantines, but not effective as to nursery stock until October 1. The following quarantine orders were promulgated as promptly as was possible under the provisions of the act:

No. 1. White Pine Blister Rust, September 16, 1912.

No. 2. Mediterranean Fruit fly, September 18, 1912.

No. 3. Potato Wart, September 20, 1912.

No. 4. Gipsy and Brown-Tail Moth, November 5, 1912.

Two of these are foreign orders and are absolute prohibitions of the entry of the goods covered, namely, the quarantine relating to the white pine blister rust and the quarantine relating to the potato

wart. These quarantines have effectually excluded the articles covered, and, through the hearty coöperation of customs officials, at a negligible cost to the government.

The two domestic quarantines, namely, (1) against the Mediterranean fruit fly in Hawaii and (2) against a portion of New England on account of the gipsy and brown-tail moths, are in good working order. The Hawaiian quarantine is being enforced with the coöperation of the quarantine officials of the Territory of Hawaii and of the Pacific Coast States, notably California, at practically no cost to the Federal government. The heartiest of coöperation has been rendered both by the Territory of Hawaii, which is directly affected, and by the Pacific Coast States, as also by the transportation companies and customs service.

The New England quarantine has only recently been established, but it promises to cause comparatively little friction and difficulty. It is being administered in coöperation with State Horticultural Inspection officers under the appropriation for the Prevention of Spread of Moths, and therefore does not draw on the funds appropriated for the Plant Quarantine Act. This New England work is closely in line with the work being done under the appropriation for the Prevention of the Spread of Moths, and it seems therefore perfectly legitimate and proper to have it carried by this fund and the existing New England force working thereunder.

Notices have been recently issued on two proposed additional quarantines. One of these is in relation to the Mexican orange fruit fly, calling for a hearing on the subject at the Department of Agriculture, January 8, 1913; and the other is in relation to imported sugar cane, the hearing being called for at the Department of Agriculture, January 7, 1913. In addition to these, quarantine of some sort will probably ultimately be taken covering fruits from the Mediterranean countries occasionally imported into the United States which are known to be infested with the Mediterranean fruit fly in their place of origin, and similar quarantine of transpacific countries in relation to the Mediterranean and other fruit flies. The latter quarantine will be merely an extension of the Hawaiian quarantine to other Pacific islands and transpacific countries known to be infested with the Mediterranean fruit fly, from which fruit is occasionally brought as ship's stores or otherwise to Pacific ports.

Control of Importation of Nursery Stock

While there has necessarily been a good deal of misunderstanding and some confusion incident to the installation of the new system of

control of the importation of nursery stock from foreign countries, the provisions of the Act and the regulations drawn thereunder are coming to be better understood. After a little over two months' experience and with the corrections which will be made as a result of that experience, there is every promise that this service will work out successfully, and give in large measure the protection needed. The heartiest of coöperation has been received from the Customs Division of the Treasury Department and this division has worked with the department to develop and perfect methods which will give all the information and protection possible under the Act.

The general effect of the enforcement of the Federal Act has been very helpful in stimulating better state inspection work, and encouraging steps are being taken in several states to secure suitable legislation and appropriation for such work. This interest has been very considerably augmented by the discovery, as a result of information obtained as an outcome of the act, of the entry of infested nursery stock into several states.

The Federal Act has also very greatly stimulated foreign countries to do better work of inspection and to provide suitable legislation to meet the requirements of the Act. The result of this is already shown in the better quality of imported nursery stock and its general freedom from infestation.

General Post Office Coöperation

The Postmaster General has coöperated very heartily with the Department of Agriculture in adjusting the postal service and issuing special orders to facilitate the enforcement of the Plant Quarantine Act in relation to nursery stock or other plant products shipped through the mails. He has ordered that all packages containing nursery stock or other plant products covered by the Federal Plant Quarantine Act or quarantines promulgated thereunder, shall be plainly marked, indicating contents, the names of the sender and consignee, as well as the destination, and that each shall bear a certificate of inspection. This applies both to domestic and foreign shipments.

The postal services of foreign countries have been notified of the requirements of the Federal Plant Quarantine Act, and postmasters of this country who may receive imported nursery stock have been notified of the requirements under the Act, which are a condition of entry and delivery of such stock.

Special notification has been given to all postmasters of Hawaii, advising them of the Mediterranean fruit fly quarantine, to prevent any fruit being shipped through the mails in violation of this quarantine. Similar notification has been sent to postmasters in New Eng-

land in relation to the gipsy and brown-tail moth quarantine. An order has been issued permitting postmasters to notify the proper state officials of the arrival and delivery of nursery stock, so that such state officials may, if they see fit, make examination of nursery stock thus imported through the mails. This last has been one of the loopholes which was most difficult to cover on account of the theory of the inviolability of mail matter. All of these orders of the Post Office Department are given in an appendix to this report.

Evasions and Violations of the Law

During the first few months of the enforcement of the Federal Plant Quarantine Act a number of forms of violations or evasions of the law have come to our notice. Some of these have been due to ignorance, and some possibly have been malicious. In the main, however, it should be stated that the nurserymen and brokers have shown a keen desire to comply with the law and regulations. Many of the discrepancies noted below will probably be prevented as a result of the amendments now made to the regulations and the new form of reporting provided for. The following items under this head may be enumerated:

1. Entry by Customs Officials and Importers in Ignorance of the Law.—A few instances of this kind have come to our notice, but the amount of such violations is negligible.

The smaller or interior customs offices, which may receive imported nursery stock very rarely, may be a little difficult to keep up to the full standard of the enforcement of the Act and regulations. No difficulty will probably be experienced in any of the twenty-five or thirty principal customs ports after the regulations have once been assimilated.

2. Entry of Nursery Stock without Proper Markings or Certification.—A good many violations of this kind have come to our notice, most of them probably the result of ignorance of the law. The Department of Agriculture has no means of determining as to whether or not the regulations as to marking and certification have been complied with, except through the reports received from state inspectors, and perhaps occasional examination of goods as they are landed at one port or another. In the matter of certification, under the regulation to take effect July 1, 1913, the parent certificate of inspection must accompany the invoice, and becomes a necessary paper of entry. After the date mentioned therefore goods without certification cannot be entered, and any failure in this regard will naturally be brought to the attention of this department by the collector of customs.

We have also been advised that many of the certificates of inspection attached to packages are "New York" editions, but this sort of fraud will be stopped under the new regulations.

There has been very little difficulty in the matter of permits and consular declarations, these features being governed directly by customs officers.

3. FAILURE IN NOTIFICATIONS.—There have been a good deal of omissions in the notifications required to be sent out by the person taking the goods from customs and paying the duty, namely, the notification to the Secretary of Agriculture and to the proper state inspector. Much of this failure has been occasioned by ignorance of the law on the part of the importers or brokers. The new arrangement entered into with the Treasury Department requires the importer or broker to transmit his notice to the Department of Agriculture through the collector of customs, and this notice is made a necessary paper of entry. This plan should insure in the future notification to the Department of Agriculture of every lot of nursery stock removed from a port of entry and will make it possible for the state inspector to receive notification from this department, at least, of all imported nursery stock consigned to his state, and will further be an absolute check on the notification which the broker is still required to send direct to each state inspector.

4. INTERSTATE DISTRIBUTION OF IMPORTED NURSERY STOCK BEFORE INSPECTION.—The Federal law requires that imported nursery stock shall not go into interstate transportation without a notification of such shipment being sent to the Department of Agriculture and to the proper state inspector. This applies not only to the port of entry as to first destination, but also to any reshipment, unless and until said stock has been inspected by some state inspector. There have been a number of violations of this provision. Nursery stock has been sent from the port of entry to the first consignee and properly reported both to this department and to the state inspector. This first consignee, has, however, probably in ignorance of the law, in several instances reshipped such stock to other states prior to its having been inspected without making the proper notification. This is a violation which is very difficult to prevent, and can only be checked up by the reports of such reshipments by the inspectors of the states to which the goods are sent. Discovery of such reshipments has been made by such inspectors accidentally or under local regulations requiring the reporting of arrival of all nursery stock. All instances of this kind should be promptly reported to the Department of Agriculture so that the question of violations can be taken up with the parties at fault and a continuance thereof prevented.

5. IMPORTATION OF PROHIBITED ARTICLES.—Violations of this kind can only be checked by state inspection. They may be accomplished by false labeling or through the ignorance of customs officials regarding prohibited plants.

6. ENTRY OF NURSERY STOCK UNDER FALSE DESIGNATION TO ESCAPE THE REQUIREMENTS OF PERMIT AND NOTIFICATION.—Two or three instances have come to our notice where nursery stock has been designated as bulbs or herbaceous plants, apparently to avoid by this means the requirements as to permit and subsequent notifications. Fortunately, suspicions were aroused in these instances, with the result that violations of this kind will probably not be attempted again by these particular individuals. The only means of checking up against fraud of this sort is to make occasional inspection of imported bulbs and other herbaceous plants. This duty naturally falls to the state inspectors.

In conclusion, it may be said that the control of imported nursery stock is rapidly working out in a thoroughly satisfactory manner in so far as the proper labeling and certification and other conditions of entry are concerned. The real utility of the Act, as it relates to imported nursery stock, must, however, finally depend on the character of the inspection given such stock by the several state inspectors. The Department of Agriculture will make every effort to encourage and aid the different states in getting proper legislation and funds to carry out this work of inspection. A feature which should be made a part of all state laws is the provision requiring the holding of all imported nursery stock, if possible, in original packages until the state inspector is on the ground to make his examinations. If not so held, the law should at least require that such importations, if opened up, should be heeled in or kept together in a fairly isolated place until inspection by the state official is possible.

The quarantine powers given in the Act, both foreign and domestic, are the ones which will bring the greatest protection to this country, and constitute the principal federal power of control given in the Act. Such quarantines, being entirely under federal supervision and enforced by federal officers, present no divided responsibility, and should succeed if sufficient means for their enforcement is provided by Congress.

APPENDIX: POST OFFICE ORDERS IN RELATION TO NURSERY STOCK

The following are the orders recently issued by the Post Office Department in relation to the Federal Plant Quarantine Act and the several quarantines promulgated thereunder.

TYPE OF LETTER SENT TO ALL POSTMASTERS OF OFFICES LIKELY TO RECEIVE IMPORTED NURSERY STOCK

DIVISION OF FOREIGN MAILS No. 246, 515 C. D.

POST OFFICE DEPARTMENT
SECOND ASSISTANT POSTMASTER GENERAL
WASHINGTON

November 22, 1912.

THE POSTMASTER, New York, N. Y.

Sir: Your attention is called to the enclosed copy of a Notice to Postmasters regarding the importation in the mails of nursery stock under the provisions of "The Plant Quarantine Act" of August 20, 1912.

A copy of the rules and regulations issued by the Secretary of Agriculture for carrying out the Act in question is also enclosed herewith, together with a circular of information to importers of nursery stock issued by the Federal Horticultural Board and approved by the Secretary of Agriculture. These enclosures will enable you to carry out the provisions of the Act so far as it affects mail importations, and will also furnish you with information to answer inquiries which may be made.

Please cause due notice of the same to be taken at your office, and advise me of your having done so.

Very respectfully,
A. A. FISHER,
Acting Second Assistant Postmaster General.

Enclosures.

The notice to postmasters referred to in the above quoted letter follows:

NURSERY STOCK FROM ABROAD

November 22, 1912.

Postmasters and other postal officials are informed that, under the provisions of The Plant Quarantine Act of August 20, 1912, nursery stock, which includes all field-grown florists' stock, trees, shrubs, vines, cuttings, grafts, scions, buds, fruit pits and other seeds of fruit and ornamental trees or shrubs, and other plants and plant products for propagation, except field, vegetable and flower seeds, bedding plants, and other herbaceous plants, bulbs, and roots, may be imported into the United States only under the conditions set forth in that Act and the rules and regulations for its enforcement issued by the Secretary of Agriculture. All articles received in the mails from abroad and containing or supposed to contain nursery stock must, therefore, be submitted to customs officials for fulfilment of the formalities of entry required by the Act and in the same manner as articles whose contents are dutiable or supposed to be dutiable.

A. A. FISHER,
Acting Second Assistant Postmaster General.

TYPE OF LETTER SENT TO FOREIGN POSTAL OFFICES IN RELATION TO PARCEL POST PACKAGES FROM FOREIGN COUNTRIES OF NURSERY STOCK.

DIVISION OF FOREIGN MAILS No. 246, 467 C. D.

POST OFFICE DEPARTMENT
SECOND ASSISTANT POSTMASTER GENERAL
WASHINGTON

November 22, 1912.

THE SECRETARY,
General Post Office, London, England.

Sir: By direction of the Postmaster General, I have the honor to enclose herewith for your information a copy of "The Plant Quarantine Act" of August 20, 1912, together with a circular of information to importers of nursery stock and rules and regulations for the enforcement of the Act, issued by the Secretary of Agriculture. You will observe that the Act provides that importers in this country must take out permits to import nursery stock as defined by the Act, and that nursery stock so imported must conform to certain stipulations concerning certification in the country of origin, labeling, and consular declaration.

The provisions of the Act and the rules and regulations for its enforcement, issued by the Secretary of Agriculture, will be applied to importations of nursery stock in the mails from foreign countries, and, consequently, will be applicable to parcel post packages, containing such stock, imported under the parcel post convention between our two countries.

Very respectfully,
A. A. FISHER,
Acting Second Assistant Postmaster General.

Enclosures.

The following order relates to the Hawaiian quarantine on account of the Mediterranean fruit fly.

ORDER OF THE POSTMASTER GENERAL

CERTAIN FRUITS, SEEDS, VEGETABLES, AND OTHER PLANT PRODUCTS UNMAILABLE IN HAWAII

Office of the Postmaster General,
Washington, Nov. 16, 1912.

Order No. 6655.

The fruits, seeds, vegetables, and other plant products, named in Quarantine Order No. 2, issued by the Secretary of Agriculture on September 28, 1912, under the authority of the Act of Aug. 20, 1912, known as The Plant Quarantine Act, are hereby declared to be unmailable in Hawaii for transmission into or through any other State, Territory, or District of the United States, so long as such order of the Secretary of Agriculture remains in force. Postmasters in Hawaii shall exercise the greatest possible care to prevent the acceptance for mailing, contrary to this order, of any of the plant products described in the order of the Secretary of Agriculture, and for this purpose shall inquire of all persons presenting parcels for mailing to any other State, Territory, or District of the United States whether they contain any of the fruits, seeds, vegetables, or other plant products declared to be unmailable.

Bananas and pineapples may be admitted to the mails in Hawaii for transmission to any other State, Territory, or District of the United States, only when accompanied with a certificate from a Territorial or Government inspector to the effect that they have been inspected and found free from the Mediterranean fruit fly.

FRANK H. HITCHCOCK,
Postmaster General.

This order is accompanied by a reprint in full of the notice of quarantine No. 2 (domestic) relating to the Mediterranean fruit fly, promulgated by the Secretary of Agriculture, September 28, 1912.

The following order relates to the gipsy and brown-tail moth quarantine:

ORDER OF THE POSTMASTER GENERAL

RESTRICTIONS ON THE MAILING OF CERTAIN TREES AND PLANTS

Office of the Postmaster General,
Washington, Nov. 27, 1912.

Order No. 6674.

Coniferous trees, or parts of trees, and decorative plants, of the area quarantined for the gipsy moth, referred to in Quarantine Order No. 4, issued by the Secretary of Agriculture, on November 13, 1912, under authority of the Act of August 20, 1912, known as the Plant Quarantine Act, may be accepted for mailing only when for transmission within such quarantined area, and when they do not exceed the limit of weight prescribed by law for fourth-class matter.

Forest plant products, field-grown plants, and plant products for propagation, of the area quarantined for the gipsy moth, and the deciduous trees or shrubs, and parts thereof, of the area quarantined for the brown-tail moth, on the movement of which restrictions are placed by the Quarantine Order of the Secretary of Agriculture, may be accepted for mailing to any point outside the quarantined area only when accompanied with a certificate of a representative of the Department of Agriculture to the effect that they have been inspected and found free from the gipsy moth and brown-tail moth, respectively, and do not exceed the limit of weight prescribed by law for fourth-class matter.

FRANK H. HITCHCOCK,
Postmaster General.

This order is accompanied by a reprint in full of quarantine No. 4 (domestic), with regulations in relation to the gypsy and brown-tail moth promulgated by the Secretary of Agriculture, November 13, 1912.

The following two orders relate to the use of the mails for the shipment of domestic nursery stock. The first of these orders (No. 6675) is an amendment of an older order (No. 6613) to bring it into conformity with the wording of the Federal Plant Quarantine Act as to definition of nursery stock. It also provides that the parcel shall be plainly marked to show the nature of the contents and the name and address of the sender. The second of these orders (No. 6696) makes it possible for the proper state official to be advised of the arrival and delivery of all mail parcels of nursery stock.

ORDER OF THE POSTMASTER GENERAL

Office of the Postmaster General,
Washington, Nov. 27, 1912.

Order No. 6675.

Paragraph 8, Section 496, Postal Laws and Regulations, is hereby amended as follows:

8. Nursery stock, including all field-grown florists' stock, trees, shrubs, vines, cuttings, grafts, scions, buds, fruit pits and other seeds of fruit and ornamental trees or shrubs, and other plants and plant products for propagation, except field, vegetable, and flower seeds, bedding plants, and other herbaceous plants, bulbs, and roots, may be admitted to the mails only when accompanied by a certificate from a State or Government inspector to the effect that the nursery from which such nursery stock is shipped has been inspected within a year and found free from injurious insects, and the parcel containing such nursery stock is plainly marked to show the nature of the contents and the name and address of the sender.

FRANK H. HITCHCOCK,
Postmaster General.

ORDER OF THE POSTMASTER GENERAL

Office of the Postmaster General,
Washington, Dec. 4, 1912.

Order No. 6696.

Paragraph 1, Section 549, Postal Laws and Regulations, is amended as follows:

Provided, That on written request, postmasters at offices of address may furnish a State officer of any State having a law regarding the inspection of nursery stock coming into the State the names of persons to whom are addressed parcels of nursery stock received from any point without the State, marked as provided in paragraph 8, Section 496; but there shall be no delay in the delivery of such nursery stock to the addressees.

FRANK H. HITCHCOCK,
Postmaster General.

TWO NEW COCCIDÆ

By T. D. A. COCKERELL

A New Coccid from the Philippine Islands

Drosicha lichenoides n. sp. ♀. Length 12 mm. or a little over, breadth 8.5, height 5; light reddish; strongly emarginate anteriorly; smooth above, with the segmentation distinct; legs and antennæ very dark brown; antennæ about as long as anterior femur+trochanter. Microscopic characters (measurements all in microns): eyes on prominent tubercles; antennæ 9-jointed, the third joint slightly constricted before the middle, the last joint long and slender; measurements of joints (1) 240, (2) 240, (3) 336, (4 to 8) each about 320, (9) 590; femora stout; claws strongly curved, the claw digitules represented by a pair of stiff bristles, pointed toward but not reaching end of claw; greatest diameter of femur of middle leg 480; tibia of middle leg 1120 long, with about 12 short spines on inner margin; tarsus of same leg (exclud-

ing claw) 480, measured along middle line; lateral margins of insect densely beset with very short hair (about 50 long), but with occasional long slender hairs, 640 to 1120 long, these long hairs (dark in color) rather numerous at the caudal end.

Habitat, Los Banos, Philippine Is., 1912 (*C. F. Baker*). Five specimens in alcohol sent by Professor Baker, who writes that in life it is covered with thin short waxy hair-like material. It lives on the bark of *Ficus nota* (I do not find any species of this name in the Index Kewensis), "frequenting so far as I observe only areas covered with whitish lichen patches, the color of which it imitates so closely as to be very effectually hidden. It is commonly attended by ants, which lead to its discovery." Dr. W. M. Wheeler has kindly determined this ant as *Dolichoderus bituberculatus* Mayr.

By the 9-jointed antennæ, this is related to *Drosicha maskelli* (Ckll.) but in *lichenoides* the ninth joint is much longer and more slender in proportion to the basal joints. *D. corpulenta* (Kuwana) is also related, but larger, longer in proportion to its width, and has very different antennæ, the joints much shorter in proportion to their breadth (in *lichenoides* the joints beyond the second are considerably longer than broad, the seventh about twice as long as broad). The longer antennal joints also separate our species at once from *D. contrahens* Walker and *D. stebbingi* (Green); the latter has 8-jointed antennæ.

A New Coccid on Grass

Recently I had a few hours collecting at Glenwood Springs, Colorado, in the company of Mr. E. Bethel. On a species of *Agropyron* (probably *A. biflorum*) we found a mealy-bug in considerable abundance. This insect, first observed by Mr. Bethel, proves to be an undescribed *Trionymus*.

Trionymus violascens n. sp. ♀. Length nearly 2 mm., width about .75 mm.; elongated, dark plum color, appearing greyish from a scanty secretion. Very short caudal tufts of white wax, but no lateral ones. Antennæ and legs light ferruginous; legs slender; claw with no inner tooth; claw digitules extremely fine, with very small knobs. Caudal lobes hardly at all developed, each with a bristle about 140μ long. Ovisac copious, pure white, forming fluffy masses on the grass stems. Labium short, about 75μ long and 50 broad at base.

The following measurements are in microns: middle leg, femur+trochanter, 175; tibia, 125; tarsus (excluding claw) 75.

Antennal segments: (1.) 38, (2.) 38, (3.) 25, (4.) 23, (5.) 26–29, (6.) 26–30, (7.) 33–35, (8.) 70–75. The normal antennæ are 8-jointed, but one specimen has a 7-jointed antenna on one side, joint 6 of this antenna measuring 48μ. Easily distinguished from *T. nanus* Ckll. and *T. californicus* Ehrhorn, both of these being yellow or pale yellowish. *T. americanus* (Ckll.) is much larger, with a differently shaped labium. In spite of the supposed generic difference, there is much resemblance between *T. violascens* and the Californian *Ripersia festucae* Kuwana. *R. festucae* has the antennæ 7 jointed, varying to 6; the labium is considerably broader than in *T. violascens*.

ON THE FEEDING HABITS OF PIMPLA (ITOPLECTIS) CONQUISITOR SAY[1]

By F. A. Johnston, *Bureau of Entomology, U. S. Department of Agriculture.*

During recent years several instances of the feeding of hymenopterous parasites at punctures made by the ovipositor in their host have been recorded.

Dr. L. O. Howard, in an article in the Journal of Economic Entomology, Vol. 1, No. 5, 1908, describes the observations of Paul Marchal on the European *Tetrastichus xanthomelænæ*, in which he was of the opinion that in many cases the ovipositor was used to pierce the egg in order that the parasite might suck its contents. Similar observations were made on this species by Mr. W. F. Fiske when it was imported into this country.

In a circular of the Massachusetts Agricultural Experiment Station (No. 23, July, 1909) on *Tetrastichus asparagi* Crawf., Dr. H. T. Fernald mentions the fact that one of the observers of this insect at Concord, Mass., reported seeing the parasite occasionally attack the eggs with its mouthparts, consuming the contents of the egg. This same habit was noticed by Mr. C. W. Prescott of Concord, Mass., and Mr. J. B. S. Norton of the bureau of plant industry. Their observations were later verified by Mr. A. F. Burgess of this Bureau.

In an article in the Journal of Economic Entomology, Vol. 3, No. 3, June, 1910, "On the Habit with Certain Chalcidoidea of Feeding at Puncture Holes made by the Ovipositor," Dr. L. O. Howard mentions observations of Dr. Paul Marchal on the habit of *Aphelinus mytilaspidis* feeding upon its host, *Aspidiotus ostreæformis*. He also mentions that these observations of Marchal were soon followed in America by Mr. J. G. Sanders, who noticed a similar habit of *Aphelinus fuscipennis* apparently feeding on its host, *Aspidiotus rapax*.

Samuel B. Doten in Technical Bulletin No. 78, September 1911, of the Agricultural Experiment Station of the University of Nevada, describes the habits of *Meraporus* sp. and *Pteromalus puparum* feeding at punctures in chrysalides of *Pontia rapæ* and of *Microbracon juglandis* feeding at punctures in the larvæ of *Ephestia kuehniella*.

While the writer was working on truck crop insects at Riverhead, N. Y., during the season of 1912, *Pimpla (Itoplectis) conquisitor* Say came under his observation as a parasite of *Autographa brassicæ*.

On October 11 and 12 two males of this species were bred from pupæ of *A. brassicæ* and on October 30, while collecting pupæ of *A. brassicæ* in the field, a female was observed trying to oviposit in a pupa of *A.*

[1] Published by permission of the Chief of the Bureau of Entomology.

brassicæ. This appeared difficult as the pupa moved violently each time that the ovipositor touched it and the parasite did not seem to be able to pierce the pupa.

Another female was observed flying around and both were captured and taken into the laboratory.

A larva of *A. brassicæ* which had spun up but had not yet pupated was placed in a vial with one of these parasites which immediately inserted her ovipositor in it twice, the second time keeping it in the larva for 30 seconds. One oviposited in a larva which had been taken from its cocoon in 25 seconds; also one oviposited in a newly formed pupa.

An active larva was placed in one of the vials and, as the parasite crawled over it, became so violent that the parasite seemed to become frightened, leaving it immediately and not again approaching it.

A larva which had spun up but not yet pupated was next put with each parasite. After carefully examining the cocoon all over with her antennæ, the parasite in the first vial thrust her ovipositor into the larva and commenced a sort of pumping motion, working the ovipositor up and down in the larva. She kept this up for 37 seconds. At the end of that time she backed away slightly, bent her head under so as to bring her mouthparts to the puncture, and began to feed on the juices of the larva which seemed to flow quite freely from the puncture. In the meantime the tip of the ovipositor remained in the puncture. She fed in this position for 20 seconds. She then again began to work the ovipositor up and down in the same puncture. She continued this for 35 seconds and then fed for 5 minutes, this time with the ovipositor entirely withdrawn. She again started to work her ovipositor up and down in the same puncture and kept it up for 35 seconds, when she withdrew it and fed for 25 seconds, then examined the cocoon and left it.

In the other vial the parasite, after thoroughly examining the cocoon, started to feed on it as did the first. She thrust her ovipositor into the larva and worked it up and down for 3 minutes and 25 seconds, then she withdrew it and fed on the juices which came from the puncture for 1 minute and 10 seconds. She then selected a new place on the larva and, after inserting her ovipositor, worked it up and down for 20 seconds. She afterward deserted this place and returned to the first place, re-inserted her ovipositor in what appeared to be the old puncture and kept working it up and down for 1 minute and 55 seconds. After this she withdrew it and fed for 35 seconds, prodded the larva a couple of times and left it.

On the following day, October 31, one of these parasites oviposited in three spun-up larvæ and two newly-formed pupæ in succession, the

time required for oviposition being 50, 45, 40, 50, 40 seconds, respectively. She then started feeding on a newly formed pupa which was put in the vial. After inserting her ovipositor in the pupa she kept working it up and down for 1 minute and 5 seconds. She then withdrew it and fed for 40 seconds at the puncture, after which she inserted the ovipositor in the same puncture and worked it up and down for 40 seconds, when she again withdrew it and fed for 40 seconds on the juices which came from the puncture. Then she worked her ovipositor in the pupa for 20 seconds, fed for 25 seconds, worked for 5 seconds and fed for 10 seconds more. She then examined the pupa and left it.

A few hours later this same parasite oviposited in 5 pupæ in 1 minute, 10 seconds; 1 minute; 45 seconds; 40 seconds; 2 minutes, 5 seconds; respectively. The other parasite during the day parasitized two spun-up larvæ and 5 pupae without feeding on any, the time required being 1 minute; 50 seconds; 35 seconds; 1 minute, 35 seconds; 40 seconds; 5 minutes, 45 seconds; 2 minutes, 45 seconds.

On November 1 one oviposited in a pupa in 2 minutes and 5 seconds. A pupa was then left in the vial for a few hours and when again examined showed that the parasite had fed on it. She immediately parasitized a fresh pupa placed in the vial, taking 1 minute and 45 seconds to complete the oviposition.

A fresh pupa was put in and the parasite started feeding on it. After making a thorough examination she thrust her ovipositor into the pupa and kept working it up and down, as in previous instances, for 1 minute and 15 seconds, after which it was withdrawn and she fed at the puncture for 30 seconds, afterward again inserting the ovipositor in the same puncture and working it up and down for 45 seconds. Then she withdrew it and fed for 30 seconds; worked for 45 seconds, fed for 30 seconds, worked for 35 seconds, fed for 20 seconds, then she went to a new place on the pupa and inserted her ovipositor and kept working it up and down for 1 minute and 40 seconds, then she fed for 35 seconds, worked 45 seconds and fed for 30 seconds. She then examined the pupa and left it.

During the day 6 pupæ had been placed in the vial with the other parasite and she was observed to oviposit in all of them but feed on none. This parasite died during the next 3 or 4 days, which were quite cold, and the other parasite showed little activity. However, on the morning of November 6 it was noticed that she had fed on a pupa which had been left in the vial over night. A spun-up larva was placed in the vial and she oviposited in it in 1 minute and 25 seconds. When she withdrew her ovipositor she placed her mouth parts to the puncture and fed a few seconds. This seemed to stimulate a desire to feed, for she immediately attacked the larva in a new spot and, after insert-

ing the ovipositor, she kept working it up and down for 40 seconds, and then she fed at this puncture for 1 minute and 30 seconds, when she left the larva. After feeding on this larva she parasitized 4 pupæ.

On the following day she fed on another spun-up larva, working the ovipositor up and down in the larva for 2 minutes, fed for 1 minute and 15 seconds; worked for 1 minute and 35 seconds; fed for 1 minute and 10 seconds; worked for 35 seconds; fed for 3 minutes and 30 seconds; and then left it.

On November 8 a pupa that had been left over night in the vial with the parasite had been fed on. After parasitizing two pupæ she fed on the third one that was put in the vial. She worked her ovipositor up and down in the pupa for 2 minutes and 45 seconds, then fed for 1 minute and 40 seconds and then left it. This parasite was destroyed by a mouse on the following night.

On November 8 four more females of this species were taken in the field and brought into the insectary. Three of them were very small and appeared weak and after trying for 9 or 10 minutes to oviposit in a pupa, they usually left it. They only lived for a day or two in the insectary. The fourth one was nearer normal size and during the five days she lived she parasitized 9 and fed on 2 pupae.

The last pupa that this parasite parasitized was on November 13 and after puncturing the pupa with her ovipositor she kept it in the pupa for over 14 minutes before she oviposited. On this date she appeared quite sluggish, as if about ready to die, and on the following morning was found dead.

IMAGINATION AND FACTS

Imagination is of great service to the scientific man. The formulation of important hypotheses has depended in large measure on the judicious exercise of this faculty. We present below a reprint of a leaflet forwarded through the courtesy of a collaborator and showing the results of allowing imagination free reign—cerebration unembarrassed by facts. The scientific attitude toward spontaneous generation, if suspected in the slightest degree by the writer, is cheerfully ignored. The fundamental biological law, like produces like, is suspended. Nature is depicted as creating an organism destined to perish without providing for the perpetuity of the species. The succession of stages observed in so many insects is disregarded. Our friend sees no advantage in food stored in the seed.

COW PEA WEEVILS

These germinate inside the pea itself, they do not, as many think, come from an egg laid on the outside of the seed by some insect.

The cause of this weevil is the pea getting hot, from hot weather, sufficient to make the weevils hatch.

When the weevil emerges from the pea his life is ended and he dies in a few hours; should the peas remain hot, weevils will continue to hatch out until the peas are riddled.

These weevils do not go to anything else, nor lay any eggs from which any other insect hatch.

Some seed men are afraid to put peas into their houses that show weevils for fear these weevils will ruin everything in their houses, which is absurd.

Peas are not hurt for planting purposes by being weevil bored, even when riddled by holes they will germinate as it is the eye of the pea, like the eye of the potato which gives out the sprout.

Some large planters in the South hunt for weevil bored peas which can be bought at a little reduction, knowing they are just as good for planting as sound peas and have more seed to the bushel, when bought by weight.

The above is only a fair sample of what might be termed "commercialized science" as expounded by ignorant or irresponsible parties presumably more interested in immediate profit than in developing a substantial business. Fortunately, such literature is commendably rare in this country. The more reputable dealers, we are happy to state, are coming into closer relation with scientific men and are, as a rule, most desirious of learning the latest developments. This latter is as it should be, since material progress is impossible without a thorough understanding of the fundamentals involved.

ENTOMOLOGICAL CONFERENCES IN PORTO RICO

During the past two years a great impetus has been given to work along the lines of economic entomology in Porto Rico. The establishment of the Experiment Station by the Porto Rico Sugar Producers Association at Rio Piedras was followed by the organization of an Insular Board of Commissioners of Agriculture and somewhat later the College of Agriculture was established at Mayaguez where the U. S. Agricultural Experiment Station has been in progress for a number of years. These institutions employ seven trained entomologists while work along the line of insect control is carried on by Guánica Centrale and the Fajardo Sugar Company. It seemed wise for these men to confer regarding their various lines of work and, after discussing the matter, a meeting was called at Rio Piedras May 25th, 1912, by Mr. D. L. Van Dine, Chairman of the Conference. The various lines of investigation were outlined, methods of work discussed and lists of entomological literature exchanged. Mr. C. W. Hooker was chosen Chairman in charge of program and meeting for the second conference to be held at the Agricultural Experiment Station in Mayaguez some time in November, 1912.

The second meeting of the Entomologists of Porto Rico was held at the U. S. Agricultural Experiment Station at Mayaguez, P. R., Nov. 26, 1912. The meeting was called to order by C. W. Hooker at 9.45 a. m. and the following papers read and discussed:

1. D. L. VAN DINE: Entomologist of Sugar, Expt. Station, Rio Piedras: May-Beetles of Porto Rico.

   There are at least six species of May-beetles in Porto Rico where we expected only three or four at the most. Determination is difficult and only possible with a long series of alcoholic or properly dissected and mounted specimens, hence it will be a long time before we can distinguish the different species or their larvæ with any certainty.

2. W. V. TOWER: Entomologist, Board of Agriculture, San Juan: Quarantine Work: (read by Mr. Crossman).

   A history of the Plant Quarantine legislation enacted and that proposed to exclude the Mediterranean fruit-fly which would ruin the insular citrus business. Careful watch is necessary to exclude injurious insects and diseases.

The meeting adjourned at 11.30 a. m. for lunch and reassembled at 1.30 p. m.

3. T. H. JONES: Assistant Entomologist, Sugar Experiment Station, Rio Piedras: The Sugar-cane Aphis and its Natural Enemies.

   The sugar-cane aphis (*Sipha graminis* Klt.) feeds only on the under surfaces of the older leaves which are bent at an angle of 45 degrees or more from a vertical position, possibly because they are better protected from rain and sun. They are attacked by four native ladybirds—*Cycloneda sanguinea* L., *Megilla innotata* Vauls., *Scymnus loewii* Muls., and *Scymnus resecollis* Muls?,—a Syrphid fly, a Chrysopid or Lacewing fly and a fungus.

4. R. C. MCCONNIE: Fajardo Sugar Co., Fajardo: A fungus parasite (Aspergillus sp.) of the Sugar-cane Mealy-bug.

   This fungus is apparently scattered all over the island and is doing good work in damp localities; hence should be very effective in irrigated fields. Mr. Garrett mentions it as doing good work in Louisiana cane fields.

5. C. T. MURPHY: Guanica Centrale, Ensenda: Sugar-cane Insects Work at Guanica.

   A systematic fight against the sugar-cane insects has been carried on at Guanica for some years. The best results have been attained by hand picking grubs and adult caculos, and plowing up the stools for hogs to root and poultry or birds to scratch. The adults are most abundant during May and June, sometimes again in August. The average number of grubs per stool has been reduced from thirty to forty in 1909 to eleven or twelve in 1912. Fifty quarts per night were sometimes taken. Burning the trash while fresh and selecting seed is necessary to combat the other cane insects.

6. S. S. CROSSMAN: Asst. Ent. Board of Agriculture, San Juan: La Changa:

   A sketch of the literature on the Changa, its habits and progress of work against it.

7. R. I. SMITH: Entomologist, College of Agriculture, Mayaguez: Entomology at the College of Agriculture:

   A sketch of the proposed work in entomology at the College of Agriculture.

8. C. F. KINMAN: Horticulturist, Agr. Expt. Station, Mayaguez: Survey of the Insular insects and need of Insect Work.

A summary of the citrus growers reports on the distribution, habits and methods of control of the Caculos.

9. C. W. HOOKER: Entomologist Agr. Expt. Station, Mayaguez, Coffee Insects.

General summary of the coffee insects of Porto Rico; Coffee ant (*Myrmelachista ambigua ramulorum* Wheeler), Leaf miner (*Leucoptera coffeella* Niet.); Weevil; Borer; Fulgorid; Spittle Insect; Cricket (*Gryllodes muticus?*) Scale, Aphis, Thrips, Fleabeetle, Hemisphaerical scale, etc.

Sr. Don Agustin Navarrete (Secretary of Porto Rico Sugar Growers Association) who was to have presented a paper on Early References to Porto Rican Entomology, owing to sickness could not be present but sent his regrets and best wishes.

After these papers were read and discussed a business session followed and plans were laid for a more general Agricultural meeting at San Juan in May, 1913.

After an exhibition of specimens and literature on Porto Rican insects, lists of named specimens and literature in the various institutions were exchanged.

C. W. HOOKER,
Secretary.

THE FIFTIETH ANNUAL MEETING OF THE ENTOMOLOGICAL SOCIETY OF ONTARIO

In 1863 the Canadian Entomological Society was founded but next year the same Society, under another name but similar in its objects and constitution, will celebrate its fiftieth anniversary. The name was changed in 1871 when the Government of the Province of Ontario passed a statute incorporating the Society as the Entomological Society of Ontario and gave it a grant. Though provincial in name it has retained its larger character and has branches not only in Toronto but also in Montreal and British Columbia. At the annual meeting held on November 19 and 20, 1912, at Ottawa, it was decided to have a special jubilee celebration in 1913, probably in September and to invite kindred societies in North America to send delegates to the meeting which will be held at the Ontario Agricultural College, Guelph, Ont., one of the oldest agricultural colleges on the continent over the Entomological Department of which Dr. C. J. S. Bethune, the veteran Canadian entomologist has charge. The founders of the Canadian Entomological Society were Dr. C. J. S. Bethune, Dr. William Saunders, late director of the Dominion Experimental Farms and Mr. Baynes Reid. Happily all three are still able to take an interest in the Society. Doctor Bethune was the first president of the Society and until two years ago was the editor of the Society's journal, *The Canadian Entomologist*. The Society is fortunate, therefore, in being able to honor, as it did at its recent annual meeting, Doctor Bethune, by electing him president of the Society in its jubilee year. Further particulars in regard to the meeting will be published at a later date. The members of the Society are looking forward to having the pleasure of the company of many of their entomological friends and co-workers from the United States on that occasion.

C. G. H.

JOURNAL OF ECONOMIC ENTOMOLOGY

OFFICIAL ORGAN AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS

FEBRUARY, 1913

The editors will thankfully receive news items and other matter likely to be of interest to subscribers. Papers will be published, so far as possible, in the order of reception. All extended contributions, at least, should be in the hands of the editor the first of the month preceding publication. Contributors are requested to supply electrotypes for the larger illustrations so far as possible. The receipt of all papers will be acknowledged.—Eds.

Reprints will be supplied authors at the following rates:

Number of pages	4	8	12	16	32
Price per hundred	$1.50	$3.50	$4.25	$4.75	$9.00
Additional hundreds	.25	.50	.75	.75	1.50

Covers, suitably printed on first page only, 100 copies, $2.00, additional hundreds, $.50. Plates inserted, $.50 per hundred. Folio reprints (50 only) $.50. Carriage charges extra in all cases.

In view of the recent discoveries in medical entomology, many of which were made by economic entomologists, it is gratifying to know that other professions are recognizing the importance of those sanitary precautions which from his knowledge of the subject, the economic entomologist deems essential. In the *Proceedings of the American Society of Civil Engineers* Vol. XXXVIII, No. 9, issued in November, 1912, there is a short paper (page 1567) on "Prevention of Mosquito Breeding" by Mr. Spencer Miller, and (page 1575) an admirable illustrated paper on "The Sanitation of Construction Camps" by Mr. Harold Farnsworth Gray. The latter paper deals with the fly and mosquito problems and treats particularly of the disposal of waste. As much of the construction work is in charge of civil engineers, articles of this character are certain to be productive of salutary results.

W. E. B.

The admission of the Apiary and Horticultural Inspectors Associations as sections of the Society means separate meetings in these two subjects and is a natural introduction to other sectional divisions. This action does not necessarily imply any lowering of membership standards. There has been a great broadening in the field of economic entomology during the past decade and there is no reason to think that the process has reached its limit. The recognition of this and the adaptation of the program to the pressing and diversified needs of our increasing membership will result in more successful meetings and a stronger association. Our aim should be to provide facilities for the satisfactory discussion of any phase of economic entomology at each meeting and to arrange for the speedy publication of the Proceedings. The imposition of time limits at our gatherings, though sometimes necessary, is unsatisfactory, since arbitrary rules may pre-

vent the proper consideration of extremely important subjects as well as to assist in eliminating the irrelevant and comparatively unimportant. The judicious summary and the general recognition of inevitable limitations have done much to promote a free exchange of views and have made our sessions correspondingly valuable for all who could attend.

The value of a figure or illustration may be somewhat accurately gauged by its life—the period during which it is used in current publications. The earliest illustrations of insects in American works were relatively crude. Riley, with his great facility for depicting natural objects, established a distinctly higher grade forty years ago. His work has given way in current prints largely to more detailed figures or the more recent process illustrations with their pleasing softness of outline. Illustrations, whether pencil, ink, photographic or colored, which can not be bettered in their respective classes, are valuable additions to literature and science. This is a standard we advocate for artists and those responsible for their work. A few really excellent figures are decidedly preferable. These are the kind which will continue to live and be reproduced for half a century or more. Let us, when drawing, painting or photographing, work for the good of posterity as well as for immediate results.

Reviews

Some Scale Insects of Mississippi with notes on certain species from Texas, by GLENN W. HERRICK. Technical Bulletin No. 2, Mississippi Agricultural Experiment Station, Agricultural College, Miss., 43 pages of text and XXXIII plates with index, 1911.

This publication gives directions for collecting, preparing and mounting scale insects. Then follows an alphabetical list of 48 species giving food plants and distribution. All but seven of the species listed occur in Mississippi and the others were collected in Texas and Louisiana. Following the list and arranged in the same order are descriptions of the scales of both sexes and of the pygidium of the female, of each species. The illustrations do not appear with the descriptions but are placed by themselves following the text. References to them appear in the descriptions and a reference to the original description of each species is also given. The pygidial characters of about 34 of the 48 species listed are shown on the plates, made from pen drawings by the author.

This publication though bearing the date of February, 1911, was not distributed until late in the year of 1912.

This bulletin is certain to prove helpful to students of the family Coccidæ, and though the insects are not treated from an economic standpoint, the publication should be in the library of every economic entomologist.

W. E. B.

Injurious Insects: How to Recognize and Control them. By WALTER C. O'KANE, 414 pages, 606 figures. The MacMillan Company, New York. $2.00 Net.

Professor O'Kane and his publishers are to be congratulated on producing an attractive book which is bound to be useful to the common people who have no particular knowledge of insect life. On the whole the subjects are well chosen, and particular attention is paid to the appearance of the injury caused by each pest. This volume differs notably from most works of its kind in two respects, viz.: (1) the insects are arranged neither from the standpoint of their relationships, nor from that of their chief food plants: (2) it is illustrated wholly by original photographs. As to the first the author states in the preface that he hopes "to avoid as far as possible the duplication inevitable where one attempts to group pests according to their host plants." The pests are grouped as follows: Attacking the roots of plants: boring in the stem and branches: feeding on the outside of the stem: leaf feeders: attacking flowers and fruit.

Though this arrangement avoids duplication, it is often an advantage to have the chief insect pests listed for each crop.

As to the illustrations, the best ones are excellent and it is to be regretted that this standard could not have prevailed throughout the book. The present writer is fully aware of the difficulty of obtaining at the desired moment the material necessary to show the life stages and work of insect pests. Yet in adhering strictly to the rule of originality, the author has used a number of photographs which do not make recognizable the insect in question. Had these been supplanted by the best photographs to be obtained from other workers, the book might have presented a still better appearance, if less original. The present writer is not yet convinced that photographs are in all cases preferable to good drawings especially to show structural characters; but when used great care must be taken to have the material in perfect condition and properly prepared. For instance, the sawflies shown in figures 419, 420, 422, and 426 have their wings crumpled and hardly add to the value of the book, though they detract from its appearance. Some other figures show poor material, and many good specimens had their wings, legs or antennæ carelessly set. The small natural sized figure shown beside the enlarged one is distinctly preferable to the usual hair line indicating size.

Pages 1 to 51 are devoted to a brief account of the injury caused by insects, their structure, senses, behavior, transformations, classification, natural enemies, how they spread, and how they carry disease. Pages 55 to 104 treat of methods of controlling insects, including mechanical means and the use of insecticides. The principal types of pumps, nozzles and other accessories are figured and described. Pages 107 to 379 describe the injury to crops by the various species of insects. It is divided into three chapters as follows: Insect Pests of Garden and Field Crops; Insect Pests of Orchard and Small Fruits; and Insect Pests of the Household and Stored Products. Insects attacking shade trees, except as they are pests of fruit trees are not included. Pages 381 to 389 contain an alphabetical list of the scientific names of the insects considered in the text; for each species, one reference is given where the reader may find a more comprehensive or detailed account if desired. The pages of the text are entirely free from references of this sort. A good index fills pages 391 to 414.

Under the heading "House Ants," page 351, one could wish that so simple and effective a remedy as naphthalene flakes scattered around the edges of the shelves or corners of the room, had not been omitted.

Notwithstanding these few criticisms, the book will doubtless fill a popular demand and should be recommended. The book is well written, and the text and illustrations are printed in such a manner as to give the volume an attractive appearance.

W. E. B.

Current Notes

Conducted by the Associate Editor

Mr. Lawson Caesar has recently been appointed Provincial Entomologist of Ontario.

Mr. Peter Cameron, author of "British Phytophagous Hymenoptera" died December 1st, 1912.

Ray Painter has been appointed assistant in entomology at the Oklahoma College and Station.

The new $100,000 building of the Wyoming College and Station will contain an entomological laboratory.

Dr. L. O. Howard lectured before the undergraduates at Oberlin College, January 7, on certain types of noxious and beneficial insects.

Mr. Henry H. Severin, recently of the College of Hawaii, is an Honorary Fellow at the University of Wisconsin.

Forest Insect Field Station number 5, of the Bureau of Entomology has been removed from Yreka to Placerville, California.

The recent death of Mr. W. G. Wright, a well known lepidopterist of San Bernardino, Cal., and author of "Butterflies of the West Coast of the United States" has been announced.

Two new ports of entry for horticultural inspection have recently been established on the Pacific coast,—San Francisco and Seattle.

Mr. R. W. Braucher is Principal of the Davey Institute of Tree Surgery, Kent, Ohio, from December 1st to April 1st, 1913.

Mr. F. A. Huntley, horticultural inspector for the State of Washington, has been appointed United States inspector for the port of Seattle.

The late Frederick Blanchard bequeathed his entomological collection to the Museum of Comparative Zoölogy of Harvard University.

Mr. William F. Kirby of the Zoölogical department of the British Museum and author of entomological papers died on November 20, 1912, at the age of sixty-eight.

Mr. George H. Hollister, a member of this association, has been made Superintendent of Keney Park, Hartford, Conn. His new duties were assumed January 1st, 1913.

Mr. A. G. Ruggles, of Minnesota, who at present is on leave of absence and entomologist for the Pennsylvania Chestnut Tree Disease Commission, spent Christmas at his home in Nova Scotia, and on his return stopped at New Haven and New York.

The Paris Academy of Sciences has awarded prizes of $500 to Dr. Carlos J. Finlay and Dr. A. Agramonte, of Havana, for their work on the rôle of the mosquito in the transmission of yellow fever.

Prof. C. F. Hodge of Clark University, Worcester, Mass., gave an address before the Science Club of the University of Wisconsin, November 6, 1912. His subject was "Fly Extermination as a Problem in University Biology."

Members of the Federal Horticultural Board were present at the meetings of the American Association of Horticultural Inspectors at Cleveland, Ohio, the first week of January.

Mr. M. P. Somes, formerly assistant to the State Entomologist of Minnesota, has recently been appointed Assistant Professor of Entomology at Clemson College, S. C.

Mr. Arthur M. Lea, formerly of the Department of Agriculture at Hobart, Tasmania, is now Entomologist of the museum at Adelaide, South Australia.

According to *Science*, Major Sir Ronald Ross, professor of tropical Sanitation in the University of Liverpool, has been appointed physician for tropical diseases in King's College Hospital, and will commence his duties next autumn after the removal of the hospital to Denmark Hill.

The American Association of Horticultural Inspectors and the American Association of Apiary Inspectors will hereafter be affiliated with the American Association of Economic Entomology, and will hold their meetings as sections of that association. This matter has been under consideration for some time and final action was taken at the recent meetings at Cleveland.

Dr. E. F. Phillips in charge of bee culture of the Bureau of Entomology, is conducting some apicultural investigations this winter at the University of Pennsylvania, Philadelphia.

Prof. Wilmon Newell, College Station, Texas, was thrown from a carriage in November and badly injured his ankle. He discarded his crutches on starting for the meetings at Cleveland.

The following item appeared in *American Fruits:* "Albert B. Scammel for the past six years county horticulturist of Mesa County, Colo., has resigned, and will go to Atlantic City, N. J., to take up the study of insect problems under the United States Bureau of Entomology.

According to *Science* a national and international testimonial is planned for Dr. Patrick Manson on the occasion of his retirement in recognition of his work in tropical medicine. A portrait and perhaps a scholarship in tropical medicine has been suggested for the national and a gold medallion for the international testimonials.

Mr. D. M. Rogers now has charge of the Federal Quarantine Inspection Service in the gypsy and brown-tail moth section of New England. All scouting and control work west of Worcester and Providence has been placed in charge of Mr. L. H. Worthley.

The State Beekeepers Association of Massachusetts was formed at Worcester, September 14, and provisional officers were elected as follows: President, John L. Byard; Vice-President, J. B. Levens; Secretary-Treasurer, Burton N. Gates.

Mr. Harrison E. Smith of the Gypsy Moth parasite laboratory has been transferred to the Cereal and Forage Crop Insect Investigations of the Bureau of Entomology and is now located at the laboratory at Wellington, Kans.

Mr. Harry S. Smith of the Bureau of Entomology, recently engaged in alfalfa weevil investigations at Salt Lake City, Utah, has accepted a position in charge of the insectary of the State Commission of Horticulture, Sacramento, Cal.

Dr. William A. Buckhout, Professor of Botany and Horticulture in Pennsylvania State College, died December 3, 1912, aged 66 years. He was the author of a number of articles on economic entomology, published in journals and in reports of the State Board of Agriculture and of the Pennsylvania Agricultural Experiment Station.

According to *Science* Dr. L. O. Howard acted as toastmaster at a complimentary dinner given December 13th at the Cosmos Club to Dr. Theodore N. Gill, "in com-

memoration of the seventy-fifth year of his life and of the fifty-fifth year of his publishing activities as a naturalist." More than one hundred attended.

Mr. J. F. Illingworth of the Davey School of Tree Surgery, began his work January 1, 1913, as Professor of Entomology in the University of Hawaii at Honolulu. Mr. Illingworth was formerly at Cornell University where he investigated the apple and cherry maggots. The results of these studies will soon appear in bulletins of the Cornell Station.

According to *Science* Professor "Edgar M. Ledyard who spent the past year at the University of Michigan where he put the entomological collection in order and left some sixty thousand Philippine insects, has returned to his work as assistant professor in entomology" in the University of the Phillippines.

Prof. P. F. Williams, State Horticulturist of Alabama, died of tuberculosis at Ashville, N. C., December 4, 1912. Professor Williams was born at Natick, Mass., September 15, 1883, was graduated from the Massachusetts Agricultural College in 1905, and in 1908 assumed the duties of assistant horticulturist at the Alabama Station. Upon the resignation of R. S. Mackintosh in 1910, Williams was appointed State Horticulturist, Professor of horticulture, and head of the department in the college and station. He had charge of the nursery inspection work. A widow and two young children survive him.

At the recent meeting of the Entomological Society of America, held at Cleveland, December 31 and January 1, the following officers were elected:

President, Prof. C. J. S. Bethune, Ontario Agricultural College, Guelph, Ont.
First Vice-President, Prof. Philip P. Calvert, University of Pennsylvania.
Second Vice-President, Prof. W. M. Marshall, University of Wisconsin.
Secretary-Treasurer, Doctor Alex. D. MacGillivray, University of Illinois.
Additional members of Executive Committee:
Prof. Herbert Osborn, Ohio State University.
Prof. V. L. Kellogg, Stanford University.
Dr. J. G. Needham, Cornell University.
C. T. Brues, Bussey Institute, Harvard University.
Nathan Banks, U. S. National Museum.
Prof. C. P. Gillette, Director Colorado Agricultural Experiment Station.
Member of Committee on Nomenclature:
E. P. Felt, New York State Entomologist.

The annual address was given Wednesday evening, January 1, on "An Entomologist in Costa Rica" and was illustrated with lantern slides.

FEDERAL QUARANTINE NOTICE

Mexican fruit fly (*Trypeta ludens*). Under authority of the Plant Quarantine Act, the Secretary of Agriculture, Hon. James Wilson has declared a quarantine against this insect and forbids the importation into the United States from the Republic of Mexico, of the following fruits or their horticultural varieties: Oranges, sweet limes, mangoes, Achras sapotes, peaches, guavas and plums.

Mailed February 25, 1913.